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ELECTRICAL REVIEW

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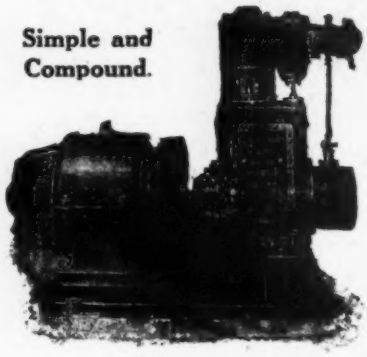

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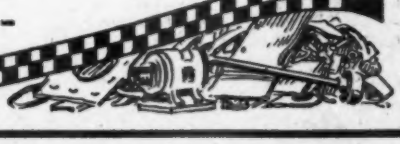

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TO "ELECTRICAL REVIEW" READERS.

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EXHIBITIONS ABROAD AND AT HOME.

WE do not suppose that there is any great keenness among those responsible for the control and management of British electrical and allied industries for occupying their heads and hands with the organisation of a big electrical and engineering exhibition in this country at a very early date. Preparations for such events, however, have to be commenced a long time in advance, and it is not too early to begin to consider the matter.

We fully approve the efforts of those who are devoting themselves to exhibitions which are being held in France and are in process of organisation for Greece, Spain, &c. The manufacturers who have had the foresight and enterprise to enter these fields, where the demands of reconstruction trade must be enormous, will, we are confident, be abundantly rewarded. It will not be overlooked that the possibilities of certain countries, which a few years ago British manufacturers did not find it worth while to trouble about, have been altogether changed, so far as we are concerned, by the course of events. Those who are present there at this juncture, when the disposition to re-open connections with Germany and Austria is probably as weak as it ever will be, will find a ready *clientèle* if they are able to meet requirements. The future attitude of such markets toward us as a manufacturing and export people will be shaped, to some extent, by what we do to-day. Indifference now may damn us for years to come, if not for ever, and give others a chance. On the other hand, if we gain a footing at once, and place on the ground, in the daily operations of the industrial and general life of the people, working examples of our products, we shall be sowing for future reaping. The carrying-out of a certain amount of export manufacturing for such markets seems to us to be a measure of urgency; to be last on the ground, when so many are alert and active, would be a most deplorable occurrence. An early foothold is of supreme value. We shall begin to secure such a foothold by co-operating in any substantial exhibition schemes that may be developed by those in authority in such countries. But we shall be doing the right thing if we remain there after such exhibitions close. We may gain great prestige by the display of typical examples of what we are able to supply, and by availing ourselves of the face-to-face transactions that officials of co-operating organisations can conduct on our behalf. But such influences will not last long if we do not watch the field at close quarters or if we permit a penetrating enemy to come and sow tares while we are asleep. Therefore, the decision of associating firms to leave behind more or less permanent commissioners is a most reasonable one, and if they are able to point to actual installations or materials which have been "made in England," and have been executed to definite contract locally, we shall have made a substantial beginning. We shall have given a proof of our desires, of our manufacturing ability, and of our good intentions.

We are sure that such considerations as these are very prominently in the minds of those of our manufacturers who are looking ahead, and who see beyond the present period of unrest, uncertainty, and export restriction. We are not going to be too optimistic because there is a lull in industrial trouble, but we venture to hope that the nation, as a whole, will shortly recognise that if we handicap ourselves as producers for export, we are laying up for temporarily better paid and more leisured industrial workers an inevitable period of ill-fortune. We have all got to pull together, and the manufacturers who have had the courage to look beyond the present situation, and begin missionary campaigns, co-operatively and otherwise, in new fields, are helping the future prosperity of the race. They

are doing such things because they have confidence that British common sense will prevail, and that the workers and the Government, too, will lend a hand.

The "new" markets, however, are only a part of the whole matter of export activity. We have our pre-war connections in the Colonies, and in many other parts of the world, which, under war-time conditions, we were compelled to leave in a state of suspense. Some of them were lost, and they have to be recovered; those which were only deferred have to be satisfied and rejuvenated. These matters should not, of course, be neglected now, however the industrial barometer may predict stormy weather or taxation sirocco. We cannot afford to leave even our oldest and most nearly related markets to yield orders spontaneously, nor to leave new markets to others because we suppose that the vast requirements of the world will be sure to bring us as much as we can handle. The observations of our Canadian correspondent respecting exhibitions, appearing on another page of this issue, merit the careful attention of British manufacturers. With our increased productivity consequent upon war-time advances in method and added capacity, there is, practically speaking, no limit to the business we can handle, and we must pursue our efforts in that conviction. All of which leads us to repeat our observation that present organised co-operative exhibition effort in European countries is the outcome of a most reasonable and proper policy which should be widely supported. This can be done without neglecting the Colonial situation.

We are prompted, however, to return to the suggestion with which we began this article, and to ask whether the time has not arrived when our responsible manufacturing authorities should seriously consider whether a big electrical and engineering exhibition should not be organised somewhere within the United Kingdom. Large numbers of buyers will be travelling to England during the next year or two. Delegates may, in small groups, be able to make tours of selected British manufacturing districts and works, as has been happening during the past 12 months, but we cannot organise visits of all the numerous inquirers, buyers, and students, arriving at different times, nor can we pilot them round even these selected works, let alone the hundreds of others that we should also like them to see. The next best thing to do is to bring together a vast collection of representative manufactures at some fairly central place, let all the world know about it, and keep it in existence for a sufficiently lengthy period to give a large number of visitors in different parts an opportunity so to time their visits that they shall profit by it.

One other matter must not be forgotten in touching even in this general way upon the subject of exhibitions. We are uniting, up to a point, in a grand scheme of electrical propaganda which shall impress the people of these islands with the advantage that accrues from doing everything electrically. The new Commercial Electrical Development Association has the matter in hand. We are convinced from experience that popular electrical exhibitions in different localities are a most successful means of appealing to and educating the public. Such exhibitions have been impossible during the war; they would have been, in some respects, worse than useless, because they would have encouraged a demand for materials and for energy that we could not supply. The position is now altered, and the public are ready for anything of the kind. The Association Director will not be blind to this opportunity.

Electricity Supply Development.

On Friday last we were privileged to share in an interesting but informal function, at which Mr. A. F. Berry, chairman of the Electrical Development Association, supported by many members of the Committee, introduced to them and to the technical Press the newly-appointed Director of Development—Mr. J. W. Beauchamp. Apart from his new functions, of course, Mr. Beauchamp needs no introduction; we have in the past been favoured with valued contributions from his pen, while as quondam deputy manager under Mr. S. E. Fedden (who was present at the ceremony), as electrical engineer to the borough of Tunbridge Wells, and for the past six years borough electrical engineer of West Ham, he has acquired a large circle of friends in the electrical industry. That Mr. Beauchamp will "make good" in his new post, we have no doubt, and in congratulating him on the appointment, we gladly extend to him a cordial welcome also.

But the occasion was memorable not merely from the personal point of view; it marks a new era in the history of the electricity supply industry—an era to which we have long looked forward. Hitherto there has been no organisation charged with the promotion of an active propaganda directed towards the development of electricity supply in this country; the industry has just "growed," making its way purely by virtue of the merits of the commodity which it supplies, without the aid of any organised stimulus or purposeful cultivation. In view of this fact, and of the many restrictions under which it laboured and still labours, the remarkable development which the supply industry attained before the war was a splendid testimonial to those merits by which it lived. But the latent possibilities which it possessed were not really revealed until the nation was called upon to pass through the fiery ordeal which is now drawing to a close—which in less than five years has led to an increase of 80 per cent. in the annual output, and has awakened, not only the nation, but even the Government, to a realisation of the wonderful capabilities of the agency at their disposal. Singular that it should be left to the Huns to administer this gigantic impulse to the industry!

It is true that there have been sporadic attempts to hasten progress from within the industry. In 1911, Dr. Ferranti drew a fascinating picture of what might be effected by the scientific organisation of a variety of apparently discrete interests, and out of his inspiring influence the Industrial Committee of the Institution of Electrical Engineers—which was not confined to membership of the Institution—was born; but the forces of reaction were too powerful, and it perished in infancy. The Incorporated Municipal Electrical Association took up the movement, and formed a somewhat similar organisation—but then came the war, and that good intention failed to mature. We must not forget, either, the Electric Supply Publicity Committee, which made fitful efforts to fill the need, but it was a whole-time job, and honorary services could not be expected to achieve success—they made no appreciable impression on the field that was to be cultivated. Due credit must, however, be given to a number of managers who by means of showrooms, exhibitions, and other means carried out very successful publicity campaigns within their own areas.

To our readers this is no new story; for years we have pointed out the urgent necessity of action to develop the sale of electrical energy, and to counter the efforts of that very active and formidable body, the British Commercial Gas Association, whose propaganda has invaded every town and village where gas supply is available, and is about to become more active and more lavish of expenditure than ever. Financial resources are the lifeblood of any such campaign. We have cited the example of our American friends, whose Society for Electrical Development, with a colossal membership and vast resources, has accomplished wonders in disseminating amongst the public a true appreciation of the possibilities of electricity in the home, the shop, and the factory. Almost every week we receive from the Society leaflets summarising its activities, and the facilities which it places at the disposal of its members for promoting the development of the sale of electricity, not only by informing and encouraging existing consumers, but also by inducing new customers to come on the mains. Statistics are given showing the harvest reaped by the Society's campaigns, which culminate in an "electricity week" of some kind or other every autumn. There is no limit to the scope of such an organisation; but, as we pointed out when the Board of Trade scheme was promulgated, while it was proposed to develop enormously the supply side of the industry, there was no sign of any intention to develop the consuming side, which was the necessary corollary to the former scheme.

We have pointed out, too, that most station engineers are primarily technical men—intensely interested in the plant

which they control and extend, but little inclined to go into the highways and byways in search of new customers. Engineers, not salesmen—but the good manager knows that it is his business to be both, and it is significant that some of our most successful undertakings are in the hands of men who insist on styling themselves "managers" rather than "engineers" of their concerns. Enthusiasm for the sales department has been conspicuously lacking, and, as we have said, electricity supply has advanced purely on its merits. Now, the first essential to success in selling is to have a good thing to sell; we have it. The next essential is to know how to sell it; this is where the Development Association will come into action. And lastly, there must be the desire to sell—not merely for the sake of profit, but for the love of the game, in the true sporting spirit. This is the part of the central-station managers; and we earnestly hope that they will whole-heartedly support Mr. Beauchamp in the strenuous task which lies before him, while he will provide them with the munitions of war.

Funds must, of course, be provided; establishment charges must be met, and there must be ample resources for working capital, though we believe the efforts of the Association will soon make it largely self-supporting. Here there will, no doubt, be difficulties to overcome; companies can deal with the matter as they please, and probably this fact has much to do with the success of the kindred Society in the United States, where nearly all the supply undertakings are in private hands; but our municipalities have to consider the views of the L.G.B. However, difficulties were made to be overcome, and we have no doubt that the authorities, in their present enlightened frame of mind, are open to conviction with regard to the necessities of the case. It is not only the supply undertakers that will benefit by the Development Association's exertions; contractors and manufacturers equally stand to profit by its efforts, and we confidently anticipate that they will heartily support the movement.

At present the country is unsettled; nerves are on edge, and progress is hindered by uncertainty as to what the future will bring forth. But the British people is sound at heart, otherwise it would never have achieved the impossible as it did so often in the Great War, and we are confident that all will come right in the end. Now is the time to get ready for the boom which we anticipate in the near future. With Mr. Berry at the helm, the organisation of the Association has made rapid progress without courting publicity, and already embraces, we believe, practically all the technical and commercial societies connected with the electrical industry, except the Provincial Electric Supply Committee of the United Kingdom—which will, no doubt, endorse the policy of the Association; it is, of course, most desirable that the campaign should have the support of the whole of the industry.

Paralysing Uncertainty.

The speech of Mr. W. L. Hichens, chairman of Cammell, Laird & Co., Ltd., of which a summary appears in our "Business Notes" to-day, brings to mind a parable told of a certain rich fool who was so obsessed with the possessions that he had secured, that he resolved to wallow at ease in the mire of selfish gratification, utterly indifferent to the ultimate issue of such course of action. The sequel to the parable is that nemesis with its accustomed inevitability cut short the career of the short-sighted reveller. What is happening at the moment is that prevailing agitations are having a paralysing effect upon industrial activity, and we are consequently losing trade in foreign markets "at a time when every effort ought to be made to increase it." Our position is being weakened instead of being strengthened to carry the heavier burden. Mr. Hichens shows that if capital is deprived of a reasonable return in order that labour may take more than its fair share, capital which makes industry, as at present conducted, possible, will take wings and fly away to less troublesome spheres of usefulness, and the means for affording employment will be jeopardised. Inequitable distribution of reward, if it occasion unemployment at home by assisting our competitors in their efforts to secure our trade, may bring to our industrial structure, which will depend more than ever on foreign trade in future, the fate of the house built upon sand. A high rate of wages but little or no work to do, at all events for some. It is frequently argued that labour is out to ensure security or continuity of employment. How we are to achieve that result by hampering industry with burdens which prevent its expansion, it is impossible to see. It is profoundly to be hoped that the workers' organisations will speedily realise the imperative necessity of banishing the prevailing paralysing uncertainty if the interests of the entire industrial sections of the community are to be safeguarded.

Municipalisation of German Electricity Works and Tramways.

The next step after the projected nationalisation or control by the Republic of the large supply works in Germany, to which reference was made recently in these columns, is the suggested municipalisation of transport undertakings and of works for the supply of water, light, and power, &c. According to a report published on March 19th, the Socialisation Commission has prepared the draft of a Bill relating to the "communalisation" of economic works. The Commission takes up the standpoint that a great need exists for socialisation on a communal basis, and that if the communes are to satisfy this requirement they must be invested with monopoly rights. The draft Bill proposes to confer this right on the communes by placing the obligation on the various States to issue legal regulations for facilitating municipalisation in this form. As a consequence, the draft Bill proposes to authorise the towns and communes to take over transport undertakings in their respective districts, together with works for the supply of water, light and power, pharmacies, the production, provision, and storage of food products and luxuries, the erection of dwellings, &c. Certain combinations of local authorities—Communal Unions, as they are termed—have already existed for a number of years past for the joint production and supply of gas and electricity, the electricity works concerned having received the name of overland central stations. It has only been possible to form these Communal Unions in the past on a unanimous decision of all the local authorities concerned. Now, however, the draft Bill proposes that such combinations shall be constituted in the future, even if opposed by some local authorities, if one or several communes possess at least one half of the total population concerned, or if the supervising or higher authorities make such a recommendation. The monopoly right is also to prevail in the case of undertakings for the establishment of which the communes have granted concessions which have not yet expired.

The new problems which will arise from the projected law will render necessary a fundamental alteration in the law of expropriation, and the Socialisation Commission considers it to be essential for a uniform law for the whole of the country to be prepared in relation to the expropriation of property. Until such a law has been passed, it is held that the States individually should legislate in the direction that expropriation should take place on the basis of the common value, that is to say, the normal trade value, and not according to the full value which has had to be paid hitherto. The full value is interpreted to be the speculative value which includes all future possibilities. Apparently this means that the undertakings would be taken over at a valuation made on behalf of the communes, and without any compensation for goodwill. The appreciation which some undertakings have experienced during the war is to be left out of consideration in arriving at the compensation to be paid, and the monetary value of the "advantages arising to the owners through the expropriation" is to be deducted from the total amount to be paid. By a coincidence it was reported on the following day (March 20th) that the Republican Cabinet had decided the previous day to commission the Economic Board to prepare a bill to bring about the Socialisation of the gas and electricity works, and the tramways.

FAULT LOCALISING: A FEW HINTS.

By H. BUJAMA.

Although the majority of mainsmen agree that fault localisation in theory is simple, the use of fault-localising sets is often dispensed with, and sets are labelled as inaccurate through some trifling error in calculation or faulty connection in the testing set—more often the latter defect. The old method of cutting and testing a faulty cable requires so little brainwork, and the rapidity with which the repair has to be effected plays so great a part in mains tests, that engineers are apt to think that the actual manual work is speedier than what appears to an outsider a comparatively simple test. Then again, one finds oneself up against an entirely different proposition to laboratory tests, weather conditions and public interest being excluded; one has still to consider the gang of men wating until one's deductions are complete, and the risk of some detail cropping up, hitherto unforeseen, that would give a faulty measurement. All these things weigh against the use of fault locaters, and we

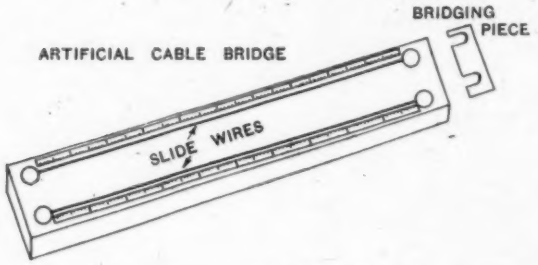

Fig. 1.—Double-slide Wire Bridge.

come to the conclusion that what is required is a simple, accurate, and quick means of fault localising, and some means whereby one can keep one's hand in, in quiet times. I have known mainsmen who appear to think that the only means of trying a new set is to wait until a cable breaks down, and when a main does actually place itself at their disposal for that purpose, they find that their anxiety to get the job through is greater than their interest in the accuracy of the new set.

I myself, some time ago, was faced with the same problem, and I got over the difficulty by constructing a double-slide wire bridge, as shown in fig. 1; by this means I was able to imitate the majority of faults that mainsmen are troubled with. By using the bridging piece and

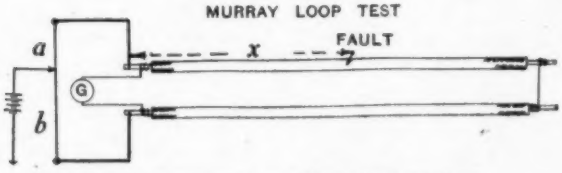

Fig. 2.—Connections for Murray Loop Test.

attaching a wire to a measured length along one slide wire for use as an assumed earth, any loop test or fall of potential test can be tried. By this means one is not only able to check the accuracy of one's set, but one is also able to acquire quickness and precision in the use of it.

With the usual bridge tests the trouble always met with is the resistance of leads and connections, and unless this point is thoroughly understood before commencing tests considerable errors are likely to be incurred.

In the Murray loop test, errors due to leads can be reduced to a minute degree by connecting the galvanometer leads as shown in fig. 2, and using leads of equal resistance to connect the cable to the bridge; this leaves the leads as an addition to each side of the slide wire, and thus if they are of equal resistance the point of balance is not affected. A good many sets are made where the galvanometer is connected across the bridge, and in these sets an unwieldy formula is given to convert the resistance of the leads into equivalent lengths of cable. In my opinion, there is nothing better for quick and accurate tests than the Murray bridge, and combined with the usual switch for interchanging battery and galvanometer it is very largely used. The other bridge test, the Varley bridge, is not so widely known, and is not made up in any form suitable for low-resistance cable tests; for long lengths of H.T. or high-resistance lines it is more suitable than the Murray bridge, but it is open to a larger error due to resistance of leads, and usually the correction necessary to counteract this defect forms a large part of the test. But even with this bridge this error can be cancelled by keeping the ratio arms $a/b = 1$, as in fig. 3. Calling the resistance of the leads y, and making them of equal resistance, we get—

$$a/b = (\text{R} + y + x)/(y + \text{L} - x).$$

If $a/b = 1$, then—

$$x = \tfrac{1}{2}(\text{L} - \text{R}). \quad \text{L} = \text{total resistance of loop.}$$

x being in ohms, it is necessary to know the resistance of the cable before the length to the fault can be obtained. Another

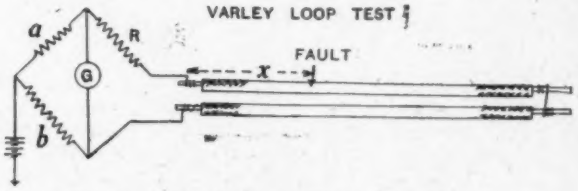

Fig. 3.—Connections for Varley Loop Test.

advantage of the Varley bridge is that its usefulness is not confined to earths only. This form of bridge can also be used for locating short circuits, the procedure being to take the resistance of the short, as in No. 1, fig. 4; call this resistance $\text{R} = x + y + z$, now reconnect as in No. 2, fig. 4, then—

$$a/b = (\text{R}_1 + x)/(y + z),$$

$$\text{and } x = (a\,\text{R} - b\,\text{R}_1)/(a + b.)$$

As in the case of the earth test, if $a/b = 1$, the resistances

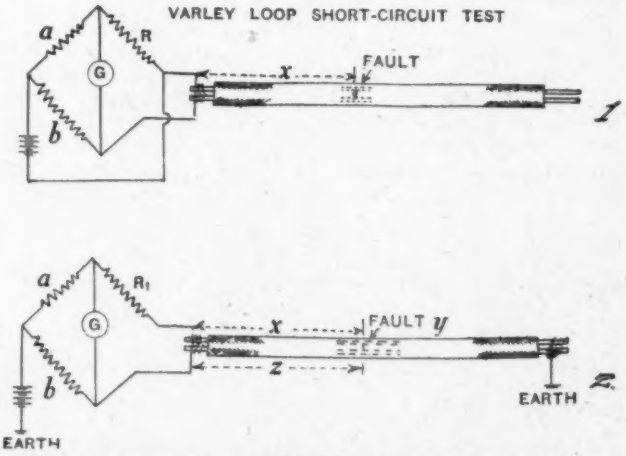

Fig. 4.—Connections for Varley Loop Short-circuit Test

of the leads, provided they are equal, cancel out, and we are left with the practically simple formula—

$$x = \tfrac{1}{2}(\text{R} - \text{R}_1).$$

This x is also in ohms, and it is necessary either to refer to a previous test record, or else obtain the resistance from makers' catalogues.

I am of the opinion that Varley loop sets would be more used, if it were not for the fact that makers do not make the third arm of sufficiently low resistance, so that one could test low-resistance cables, by using a one-to-one ratio on the ratio arms. This would mean that for low-resistance

cables, running, say, to 0·1 ohm for the complete loop, it would be necessary to have a third arm divided up into 0·001 sections; that would mean one ten-contact unit of 0·01 ohm per contact, and another of 0·001 ohm per contact, making a minimum of 0·001 ohm, and a maximum 0·1 ohm in the third arm. The secret of accuracy of all bridge tests is to get all the arms of nearly equal resistance, and for low-resistance tests to use low-resistance galvanometers and low voltages.

I suppose one of the most difficult faults that a mains engineer comes up against is the case of a short where the cable has also gone to earth, for unless he has a loop cable handy, or is able to run an artificial loop, there is no well-known test that will satisfy him. I have found that this kind of fault can be dealt with fairly well by taking two ordinary resistance tests, one at either end of the faulty cable. Then if the resistance of the short $= z$, fig. 5—

$$R = 2a + z,$$
$$R_1 = 2b + z.$$

Then we can cancel out the resistance of the short z, and leave—

$$2a - 2b = R - R_1.$$

If total resistance of faulty cable $= x$,

then $$2a + 2b = x,$$

and $$R - R_1 = -4b + x,$$

$$b = \tfrac{1}{4}(R_1 - R + x) \text{ ohms.}$$

I do not consider this anything like as good as the previous tests, but failing other means, it certainly is a good last resource, and with proper attention to obtaining good connections, and deducting the resistance of leads from tests, it is workable. There is one serious drawback due to the resistance of the short circuit varying between tests, but by rechecking tests at either end, this can be verified.

A good deal of thought is necessary to obtain the right kind of set for the job, for where the Murray loop test is capable of great accuracy on short lengths of low-tension cable, the Varley loop is better suited for long lengths of

Fig. 5.

high-resistance or E.H.T. lines. Again, where 1 per cent. error in a 5-mile line represents 88 yards, the same percentage error in 200 yards only represents 2 yards, which means that in short-distance tests accuracy is not so important. Then, again, there has to be considered the value of the resistance of the fault; for while in E.H.T. lines it might be necessary to localise a fault of 20,000 ohms to earth, it is unlikely on low-tension cables that one would have to deal with a higher resistance than a few ohms. What usually outweighs all these points in the selection of any set is the price of the set, the Murray loop sets being considerably cheaper than Varley loop sets; but however expensive a set might be, with proper attention to the details mentioned, and time given to obtaining precision by the use of the double-slide wire bridge, it would require a saving of only a small amount of expensive navvy work to repay the cost of the set.

Employment of British Labour Overseas.—The Minister of Labour informs the Department of Overseas Trade that numerous inquiries are received in the Employment Department of the Ministry from individual workmen and from Trade Unions as to the conditions and manner of obtaining employment abroad. The Minister understands that the work of reconstruction on the Continent will be controlled by the Governments of the countries concerned; but it is probable that British firms will be afforded an opportunity of participating. The Minister would be glad to be informed from time to time of contractors who may be expected to employ British workmen abroad, and the type of work upon which they will be engaged, in order that workmen who wish to obtain such work may be put in touch with the contractors.—*Board of Trade Journal.*

EXTRAS IN ENGINEERING CONTRACTS: AN IMPORTANT DECISION.

[BY OUR LEGAL CONTRIBUTOR.]

The case of Nott *v.* The Mayor, &c., of Cardiff, in which the House of Lords recently gave judgment reversing the decision of the Court of Appeal, decided certain questions of very great importance to all who are concerned with contracts for works.

It is important for two reasons—first, because it involved the discussion of a vital point which arises upon a form of contract in common use, and in the second place it appears to establish quite a new principle—or to establish a point which, so far as the writer is aware, is not covered by judicial authority.

The material facts may be very briefly stated. In 1910 the Cardiff Corporation was minded to contruct a reservoir, and entered into a contract with that object. The contractor undertook to complete the works according to a specification in the usual way. There was a large sum involved—the contract price was £201,077 7s. 4d. The dispute arose about a claim for extras which was eventually referred to arbitration. The Corporation declined to admit the claim, on the ground that the engineer had given no certificate in writing as required by the contract. An arbitrator found for the contractor, awarding him £11,933, but stated his finding in such a way that it could be reviewed by the Court. Eventually it reached the House of Lords, when the arbitrator's decision was upheld.

This being a brief outline of the facts, it is desirable to look at the matter a little more closely. It was common ground (1) that in order to justify a claim for extras, the certificate of the engineer was a condition precedent; (2) that in the present case no certificate had been given. How, then, was the contractor able to substantiate his claim?

The contract expressly provides (by Clause 3) that "no extra charges in respect of extra work or works will be allowed unless they are clearly outside the spirit and meaning of the specification, nor unless such works shall have been ordered in writing by the engineer." Then there was an arbitration clause, which was substantially the same as that which appears in the common forms of contract. The material words are:—"In case any dispute or difference shall arise between the Corporation or the engineer on their behalf and the contractor, either during the progress of the works or after the determination, abandonment, or breach of the contract . . . as to any objection by the contractor to any certificate, finding, decision, requisition, or opinion of the engineer, then either party shall forthwith give to the other notice of such dispute . . . and it shall be referred to . . . arbitration."

The clause goes on to provide that in the event of the parties not agreeing to arbitrate, the arbitrator may decide whether the dispute or difference shall be immediately determined, or whether it shall await the completion of the work.

Another clause provides:—"It is to be distinctly understood that the Corporation shall not be liable to the payment of any charge in respect of such additions, alterations, or deviations, unless the instruction for the performance of the same shall have been given *in writing* by the engineer, with other ancillary provisions for the protection of the Corporation."

Disputes arose at an early stage. The engineer gave various orders, which the contractor said involved the execution of extra work, while the engineer said they were covered by contract prices, and the Corporation took the point that in any event the absence of a certificate was fatal to the claim of the contractor. The Arbitrator found as facts that the resident engineer, with the concurrence of the engineer, improperly requested the contractor not to make claims for extra work under Clause 3 *(supra)*; that the engineer required the contractor, without extra payment, to execute work and supply materials extra to the contract; that the contractor objected to such requirements; that disputes arose which the engineer decided against the contractor; and that he improperly refused to give written

instructions in respect of work which the Arbitrator said was extra.

The Lord Chancellor, in the course of his judgment, pointed out that the dispute really turned on the meaning of Clause 128, as to which he said :—"The effect of this clause with regard to a dispute as to the refusal of the engineer to give an order in writing for any item as an extra is, in my opinion, this: The clause provides for any dispute on such a point being arbitrated at once, if it is decided on a preliminary arbitration that it ought to be decided at once. If the arbitration is forthwith held, it appears to me that the award by the Arbitrator that the item in dispute is an extra, and therefore ought to have been ordered in writing, takes the place of the order in writing. The arbitration is an appeal from the refusal by the engineer to give such an order, and the meaning of the provision is that in that case the contractor may go on with the work, relying on the *interim* award as putting him in the same position as if the engineer had given an order in writing.

"On the other hand, on the preliminary arbitration it may be determined that the decision shall await the completion of the work. What the contract contemplates is an order in writing before any extra work is done; and if the arbitration stands over, either as the result of a preliminary arbitration or by consent, till the completion of the works, it seems to me that the meaning of Cl. 128 is that the award then to be made, if in favour of the contractor, shall have the same effect as if an order in writing had been given. This is indeed an *a fortiori* case as compared with the case of arbitration before the work had been done."

Applying that principle to the case before him, Lord Finlay pointed out that the arbitrator had found, as a fact, that there were disputes as to whether certain items were extras, and that those disputes were allowed to stand over by agreement. Those disputes were settled by the arbitrator in favour of the contractor.

He also pointed out that the Corporation had relied on a clause in the contract which provided that any instructions given verbally were to be deemed as instructions for the proper execution of the works not involving extra charges. Dealing with this he said: "The dispute that arose was whether the engineer was entitled to give merely verbal orders in respect of these items. It is an appeal from the decision of the engineer, and if the contractor succeeds, he must be in the same position as if the engineer had given the order."

The other members of the Court (with the exception of Lord Sumner) delivered judgments agreeing that the appeal should be allowed, and in the result the contractor had judgment.

Thus it has been decided, and, so far as my knowledge extends, decided for the first time, that the refusal of an engineer to grant a written order, may (even in the absence of fraud or conduct which is improper in the legal sense) be reviewed by an arbitrator. How far is this a principle of general application? That question can best be answered by inquiring whether it would apply in a case where the parties were bound by the ordinary form of contract.

That form (*e.g.*, the R.I.B.A. form) usually provides that subject to certain exceptions "in case any dispute or difference shall arise between the employer or the architect on his behalf, and the contractor either during the progress of the works or after the determination, abandonment, or breach of the contract as to . . . . any matter or thing arising thereunder," the same shall be referred to arbitration.

Now, it is very usual to provide that extras must be ordered in writing; but if there is a dispute between the architect (or engineer) and the builder (or contractor) as to whether a particular piece of work is an extra, it seems clear that upon the authority of Nott's case, this could be referred to arbitration. In a legal text-book published in 1913,* the following opinion was expressed :—"Suppose there is a dispute as to whether a particular piece of work ordered to be done is extra or not, the contractor should at once give notice in writing that the question is in dispute."

To sum up, a general conclusion which may legitimately be drawn from the case under notice is that, no matter how stringent the provisions of a contract may be in the direction of providing for written orders for extras, the decision of the engineer not to give a written order may be reviewed by arbitration.

This is an important and far-reaching result; and it is difficult to see how it can be avoided in any future contracts, unless contractors are willing to allow the question "extra or not" to be submitted to the final decision of the engineer.

It is very common for certain questions to be finally decided by the engineer—*e.g.*, a question as to discrepancy in the drawings or the removal of improper materials—but there is no form of contract in common use whereby contractors have submitted to be bound hand and foot by the decision of the engineer as to what is or is not an extra. If by refusing to give a written order the engineer could, in effect, secure to himself the right to decide this question, a reference to arbitration would be without any value—inasmuch as the claim of the contractor would immediately be met by the answer, "You have no written order."

NOTES FROM CANADA.

[FROM OUR SPECIAL CORRESPONDENT.]

The daily papers here recently reported that it was probable that, with the return of Peace, the idea of utilising the power of the tides at Cape Split, on the Minas Channel, a branch of the Bay of Lundy, would be revived. It is said that the project was first undertaken by Dr. George B. Cutten, president of Acadia College, Wolfville, Nova Scotia, and Prof. R. P. Clarkson, an American professor of engineering at Acadia, and that it has been endorsed, both from the engineering and commercial standpoints, by a New York firm of consulting engineers.

At the spot referred to above, the tide rises from 35 to 45 ft., and runs with remarkable rapidity; a test of the plant which it is proposed to use is reported to have been made last year by the chairman of the American Society of Mechanical Engineers. An initial development of 5,000 electrical H.P. is proposed, but it is estimated, apparently, that much more than this can ultimately be generated.

Two gentlemen (Messrs. E. T. Brondon and E. V. Buchanon) recently left Canada to visit several European countries on behalf of the Hydro-Electric Power Commission of Ontario.

The writer has reason to believe that this Commission is, other things being equal, favourably disposed towards doing business with Great Britain, and, as it is probably the largest purchaser of electrical supplies in the world, opportunities of securing a favourable business connection with this body should not be ignored. The Commission buys all kinds of electrical goods in bulk, and sells them to the municipalities, and its requirements in the way of transformers, switchgear, electricity meters, high-tension insulators, &c., are very large, and are steadily on the increase. It is natural that a supply authority serving territory about the size of England, and meeting the electrical needs of a population of over a million persons, needs supplies on a big scale.

Several American firms here are making great efforts to sell farm-lighting sets, and they have apparently met with a good measure of success; the sets consist of a low-voltage (about 20 volts) generator, driven by a gasoline engine, and this unit charges a battery which is part of the complete set.

The Imperial Trade Commissioner at Toronto recently reported that disappointment is expressed locally that arrangements are not more generally being made for selling organisations here. (This was in reference to British manufacturers generally.) He added that their principal competitors had already taken steps in this direction.

The writer recently approached one of the professors of Toronto University, on the subject of engineering graduates

* The "National Form of Building Contract," by Valentine Ball and Hope, at p. 68.

going over to England to get at least a portion of their engineering training there. This is a matter which has been advocated several times in these notes—practically every Canadian-born engineer is an American engineer under present conditions; he knows nothing, and cares little, about British firms or British methods, as a rule.

The professor referred to above was very sympathetic towards this idea, and went so far as to mention the matter to the Council of the University; the Council apparently would welcome any efforts that might be made to enable engineering graduates to obtain some experience in England. It is believed that the Council would willingly recommend some of its best graduates to English firms, and it is more than likely that McGill University at Montreal would be favourable to such a policy, although no definite information has been obtained.

The idea of the writer is that it should be made easy for engineering graduates to go to Britain and get some training there. There is no doubt that the influence of a native-born Canadian engineer, with strong leanings towards Britain, due to a familiarity with the country, its people, its methods, and its splendid engineering works, would be greater than that of the British engineer who comes out here. At the same time, the engineering works at home should familiarise themselves with conditions and requirements over here as much as possible; the employment of a few men who had had several years of experience in this country would probably be an advantage.

Is this not a matter which the B.E.A.M.A. might consider?

The Canadian National Exhibition will, as usual, be open for two weeks in August and September.

This is an exhibition which has been held annually at Toronto since the year 1879; it has grown steadily in popularity, and during the last few years almost a million people have visited it each year, coming from all parts of Canada and the United States.

Exhibits shown undoubtedly have an effect over a very wide field, which embraces a very large potential market.

The writer has for several years held the opinion that Great Britain should be particularly well represented at this exhibition.

The following extracts from the Reports of the Dominions' Royal Commission, which sat in Canada in the early part of 1917, are worth quoting at length now that the world is striving to return to normal conditions, as they have special reference to this subject:—

Extracts from Fifth Interim Report of the Dominions' Royal Commission.

We received evidence from several quarters in Canada with regard to exhibitions. There is a general agreement that the Toronto Exhibition, which has been held annually since 1879, has proved itself to be well worthy of support. Covering some 165 acres, and possessing permanent buildings, which are worth about $3,000,000, it is practically self-supporting, and is able to give about $48,000 per annum in prizes for live stock, no other money prizes being awarded. In recent years nearly a million visitors have attended in the fortnight, during which the Exhibition is open, and by their entrance fees pay practically all costs. No floor charge is made, but a small fee is levied for show cases.

For some years efforts have been made to induce your Majesty's Government to erect a permanent building sufficiently large to admit of an adequate display of the produce and manufactures of the United Kingdom; but hitherto these requests have been without result. As this Exhibition has justified its existence by the large numbers of visitors who patronise it, and by the approval and co-operation accorded to it by the Dominion and Provincial Governments, the Manufacturers' Association of Canada, and the Boards of Trade, we consider that a grant might well be made, so as to show United Kingdom goods in a leading centre in Canada, where the produce and manufactures of the United States are now given undue prominence compared with those of Canada's Mother Country.

The reports were signed by Lord D'Abernon, chairman; Sir H. Rider Haggard; Mr. T. Garnett; Mr. W. Lorimer; Mr. J. Tatlow; Sir Alfred Bateman; Sir George Foster (Canada); Mr. J. R. Sinclair (New Zealand); Sir J. W. S. Langerman (South Africa); and Sir Edgar Bowring (Newfoundland).

It is not clear from the above extracts what kind of an exhibition this is, but it may be stated that besides agricultural, mining, and forest products of all kinds, there are shown all varieties of manufactured goods, including electric fittings and accessories, motors and appliances, telephones, lamps, besides electrical accessories for motor-cars, &c.; there are also many different kinds of machinery in actual operation, many of them motor driven, in fact, it is like a very good sample of its kind that one might see in Great Britain.

A British Isles building, with suitable exhibits, would be sure to attract a great deal of attention, and could hardly fail to result in the firms of the "old country" becoming better known and patronised; especially where it could be shown that prices were reasonable.

SOME NOTES ON POWER-FACTOR INDICATORS.

By G. W. STUBBINGS.

The attention that has been given in recent years to the regulation of the power factor of alternating-current circuits has brought about a widely increased field of application of the power-factor indicator. The use of this instrument is also extending in test rooms for alternating-current meters, the use of a power-factor meter in conjunction with a phase-shifting transformer for varying the phase angle of the voltage applied to the pressure circuit of the meter with respect to the current in the main coils being extremely convenient for testing meters of this class. The principle of action of a power-factor meter is by no means as obvious as that of an ammeter or a wattmeter, and a few words on this subject may be of interest to engineers who have been unable to find the time to look into this matter.

The power-factor meter is an instrument of which the moving system has no control—that is, it is free to take up any position when disconnected, apart from unavoidable friction. In the single-phase instrument this moving system consists of two coils arranged at right angles, the planes of these coils intersecting on the axis of rotation. Both these coils are connected across the supply voltage; the one in series with a non-inductive resistance, and the other in series with a reactance. The moving system is placed symmetrically between two coils which carry the current of the circuit. If the voltage at any instant be $v \cos pt$, and if the field produced by each of the coils of the moving system be equal, the combined effect of these two fields will be to produce a rotating field proportional to the voltage, whose angular speed is pt. In the diagram, fig. 1, let O A be the direction of the field due to the current coils, and O B the direction of the axis of the coil of the moving system connected to the non-inductive resistance; it is clear that if at any instant the field due to the fixed coil is proportional to $c \cos (pt - \phi)$, the angle between this field and the rotating field will be $pt + a$, where a is the angle B O A. The torque acting upon the moving system will be,

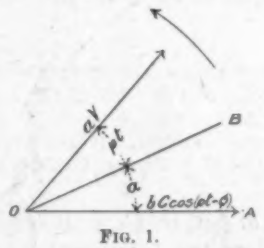

Fig. 1.

therefore, $a v \times b c \cos (pt - \phi) \times \sin (pt + a)$. As the moving system is without control, it will take up such a position that the average value of this torque is zero. This condition is fulfilled when the average value of $\cos (pt - \phi) \sin (pt + a)$ is zero.

$$\cos (pt - \phi) \sin (pt + a) = \sin (pt - \phi + a) + \sin (\phi + a),$$

the average value of which is evidently $\sin (\phi + a)$.

The given condition, therefore, becomes $\sin(\phi + a) = 0$, or $a = -\phi$; the angle a, measured in the opposite direction to that of the rotation of the field due to the moving system, will, therefore, give the angle of lag. It is easily seen that with a leading current the condition for zero average torque is $a = \phi$, the deflection of the pointer being in the opposite direction. As the scale of the instrument is graduated to show the power factor, or $\cos\phi$, the law of the instrument will give an open scale in the neighbourhood of unity power factor.

It will be noticed that the equation $\sin(\phi + a) = 0$ is also satisfied by $\phi + a = \pi$, giving $a = \pi - \phi$. It is easy to show that such a position of the moving system is unstable. Consider the moving system in such a position displaced by a small angle β. The resulting torque will be $\sin(\phi + \pi - \phi + \beta) = -\sin\beta$. This torque is, therefore, negative, and will increase the angle of deflection β, till the moving system takes up a position represented by $a = -\phi$.

Power-factor meters for balanced two or three-phase circuits can be constructed on lines similar to single-phase instruments. The rotating field in this case can, however, be obtained from the actual circuit without any phase-splitting device. The action of the instrument will be precisely similar to that of the single-phase type.

Three-phase power-factor meters for unbalanced circuits have three current coils, carrying currents proportional to the line currents, symmetrically arranged.

The resultant magnetic effect of these three coils will be to produce a rotating magnetic field which, however, will not be constant in magnitude or uniform in velocity. The moving system will produce a rotating field proportional to the voltage, which can be considered as constant in direction and angular velocity. In view of the general lack of uniformity of the field due to the current coils, it will be convenient to consider the instrument as a combination of three single-phase instruments. The average torque acting on the moving system, due to the action of each current coil, will be proportional to $C V \sin(\phi + a)$. The total torque will therefore be—

$$K_1 C_1 V_1 \sin(\phi_1 + a) + K_1 C_2 V_2 \sin(\phi_2 + a) + K_1 C_3 V_3 \sin(\phi_3 + a),$$

C_1, V_1, ϕ_1; C_2, V_2, ϕ_2; C_3, V_3, ϕ_3 being the currents, voltages, and phase angles of the three phases respectively. If $V_1 = V_2 = V_3$, this can be written—

$$K V \{C_1 \sin(\phi_1 + a) + C_2 \sin(\phi_2 + a) + C_3 \sin(\phi_3 + a)\},$$

$$= K V \{(C_1 \sin\phi_1 + C_2 \sin\phi_2 + C_3 \sin\phi_3)\cos a + (C_1 \cos\phi_1 + C_2 \cos\phi_2 + C_3 \cos\phi_3)\sin a\}.$$

This expression can be written: $K V \{M \cos a + N \sin a\}$, and equating this to zero gives the condition for equilibrium of the moving system: $M \cos a + N \sin a = 0$, therefore $(M \cos a + N \sin a)/\sqrt{M^2 + N^2} = 0$, and $\sin(a + A) = 0$, where $A = \tan^{-1} M/N$; therefore $a = -A$, and $\cos a = (C_1 \cos\phi_1 + C_2 \cos\phi_2 + C_3 \cos\phi_3)/\sqrt{M^2 + N^2}$.

This expression, it will be noticed, differs from the usually-accepted definition of the power factor of an unbalanced three-phase circuit as being the ratio of the watts to the voltamperes or—

$$(C_1 \cos\phi_1 + C_2 \cos\phi_2 + C_3 \cos\phi_3)/(C_1 + C_2 + C_3).$$

It has also been proposed to define the power factor of a three-phase circuit as the ratio of the actual watts to the maximum watts produced by relative rotation of the current and voltage vectors. If the angle of rotation of the voltage vectors be θ, the watts produced by such rotation will be—

$$C_1 \cos(\phi_1 + \theta) + C_2 \cos(\phi_2 + \theta) + C_3 \cos(\phi_3 + \theta),$$

since θ will be negative, to increase the power in a lagging circuit. Differentiating this expression with respect to θ, and equating to zero, as the condition for maximum power we obtain—

$$C_1 \sin(\phi_1 + \theta) + C_2 \sin(\phi_2 + \theta) + C_3 \sin(\phi_3 + \theta) = 0.$$

This is a condition precisely similar to that obtained for the equilibrium of the moving system of the three-phase power-factor meter. The angular deflection of this instrument will give the phase rotation of the voltage vectors required to give maximum power in the circuit since $\theta = a$, and the condition for maximum power will be $\theta = a = -\tan^{-1} M/N$; the power factor as defined will then be—

$$\frac{C_1 \cos\phi_1 + C_2 \cos\phi_2 + C_3 \cos\phi_3}{C_1 \cos(\phi_1 + a) + C_2 \cos(\phi_2 + a) + C_3 \cos(\phi_3 + a)}.$$

The denominator of this fraction can be written—

$$(C_1 \cos\phi_1 + C_2 \cos\phi_2 + C_3 \cos\phi_3)\cos a - (C_1 \sin\phi_1 + C_2 \sin\phi_2 + C_3 \sin\phi_3)\sin a = (C_1 \cos\phi_1 + C_2 \cos\phi_2 + C_3 \cos\phi_3)\cos A + (C_1 \sin\phi_1 + C_2 \sin\phi_2 + C_3 \sin\phi_3)\sin A,$$

where $A = \tan^{-1} M/N$

$$= (M^2 + N^2)/\sqrt{M^2 + N^2} = \sqrt{M^2 + N^2}.$$

The expression for the power factor becomes, therefore—

$$\frac{C_1 \cos\phi_1 + C_2 \cos\phi_2 + C_3 \cos\phi_3}{\sqrt{M^2 + N^2}} = \cos a.$$

The cosine of the angle of deflection of the three-phase power factor indicator will, therefore, indicate the power factor as defined by the ratio of actual watts to the maximum watts produced by rotating the voltage vectors relatively to the current vectors.

ELECTRIC-ARC WELDING.

At Glasgow, on March 18th, Mr. H. M. Sayers's paper on "Regulations for Arc Welding" (an abstract of which appeared in our issue of December 20th, 1918) was discussed before the Scottish Centre of the Institution of Electrical Engineers.

Major James Caldwell, who opened the discussion, showed lantern slides descriptive of electric welding applications both in this country and in America. He briefly referred to recent advancement in the resistance processes, more particularly the development in joining thick plates by means of spot welding. For this purpose it had been found essential to provide correct current pressure, time interval, and type of electrode. For this purpose it had been determined even greater success was achieved than in the joining of thin sheet metal by these means. It was most important that operators should receive intensive training, and thereafter be retained as welders when proficient. It was now possible to secure successful welding of any class of steel, and examples of alloys so treated and shown at the meeting included a sample of the welding of a high-speed cutting edge on a mild steel tail shank. As regards electric cutting edge on a mild-steel tail shank. As regards electric supply conditions, 60 volts on open circuit with D.C. or A.C. connected through a resistance, choking coil, or constant-current transformer was sufficient. There was no notable difference in the mechanical characteristics of welds made with either D.C. or A.C., although certain electrodes were much more suitable for one form of current than others. The quantity of current employed in making a weld was of great importance. Important results were obtained with increased current provided that the speed of working was greater, although more expert manipulation was required. With the extensive application of electric welding to ship construction it was considered of the utmost importance that the work should be controlled, not only in its broad outlines, but also in all its details, by men thoroughly acquainted with the factors essential to success. On the other hand, in order to extensively employ electric welding in ship work it might be necessary to cut loose completely from many of the traditions of conventional practice. Special progress would therefore be obtained in a shipyard specially designed and equipped to employ welding methods wherever these had been demonstrated to be the most appropriate.

Mr. Flood said that up till now they had been placed more or less in the hands of hawkers of electrodes—people who had studied the subject from the purely electrode point of view. It was not until quite recently that he had found a firm of electrode makers which could give satisfactory electrical data on which plant could be ordered as an efficient commercial proposition. He felt that if A.C. welding could be developed there was a big future for the A.C. side. For some years, however, it would probably be necessary to use D.C. owing to the nature of the work. With regard to rules and regulations, it was premature to decide anything definite beyond those for the safety of the operator. There they should try to arrive at some standard recognised protection for the eyes.

Mr. R. B. Mitchell said that testing electrically-welded ships after completion would be an extremely difficult matter, and he did not think that the petroleum test would be sufficient. Single-phase supply from three-phase transformers would prove quite satisfactory in most cases when a number of welders were in use, and there was no reason to anticipate

trouble from any slight out-of-balance which might occur. The protection of the operators' eyes might be easily got over, but it was more difficult to safeguard the workers in the vicinity. Some sort of movable enclosure in which the welder would work might be provided. He agreed that the conditions were not favourable for D.C. supply from the mains of a supply undertaking. It could only be for comparatively small requirements that such a supply could be allowed, while on grounds of economy if would not be worth while except for occasional work, and then would not be welcome to the supply authorities on account of the disturbance to pressure which would be caused. Safeguards must be introduced to limit the current on striking the arc, and if the work itself was to be earthed, the B. of T. would require to alter its rules, but this difficulty would only arise when the welding current was taken direct from a supply authority's mains. He did not know of any case where electric welding had been carried out regularly without the introduction of a motor generator or transformer.

Mr. Serrod said that electric welding had rescued the Glasgow T.C. tramways department from a predicament. Castings which had formerly been scrapped were sent to the welder, and made as good as new. So far as maintenance work was concerned, electric welding would be a valuable adjunct to any big concern.

Mr. A. Page said it seemed that the only justification for talking about electric welding in shipbuilding was that it would cheapen construction. The shipbuilder was presumably not taking up the matter too enthusiastically. Given good operators, he did not see why they should not soon have the same opinion of electric welding as they had of the product of the blacksmith. When power station engineers had faced the load for electric furnaces he did not think that anything put on their mains for electric welding would seriously affect the voltage.

Major Caldwell, who replied on behalf of the author, said that in Government work they had to use electrodes that were available, as they could not stop operations and start a technical discussion. In spare time, however, they carried out tests, and satisfied themselves that 60 volts with any electrode, and with any current was good enough to give satisfactory results without any resistance at all. As regards A.C. they had to consider the type of the electrode, and the more current they could use and the lower the voltage, the better the weld. For testing, several attempts had been made to test by means of the resistance of the welded parts and also by X-rays, but so far the petrol and hammer tests were the most successful. With a low voltage of, say, 60 volts, visual inspection might be sufficient. For the protection of men in shipbuilding, his department had had staging erected outside the hull, with canvas partitions between each operator. He suggested the advisability of instituting investigations into the loss of metal deposited, which he found on experiment varied from 1 to 40 per cent. In repairs electric welding had certainly a great future. As to labour, the shipyards had taken up the matter to a certain point, but it broke down when they came to labour. They had over 1,000 men at electric welding during the war, and it would be a pity if they could not be used pending the training of others. The supply of current was one of the handicaps to advancement latterly.

HYDRO-ELECTRIC POWER IN CANADA.

Reporting on the power possibilities of the St. Lawrence River, the Consulting Engineer to the Commission of Conservation of Canada says there is a shortage of hydro-electric power which is being keenly felt both in Canada and the United States, and strong efforts are being made by private interests to obtain control of the enormously advantageous power in, and adjacent to, the international boundary waters.

It had been hoped that power would have been available from the large development at the Cedars Rapids on the St. Lawrence River, but this power, although conveyed through the territory of the municipalities requiring power, was taken *en bloc* to the works of the Aluminium Co. of America, situated at Massena, N.Y. Notwithstanding the suggestion that the needs of Canadian municipalities might be supplied by power brought back from Massena to Canada, this has not been done, but, instead, it is being sold to municipalities in the northern part of New York State. Great industrial advantage has followed the utilisation of this power generated in Canada and exported to the United States. There is very strong opposition, especially throughout Ontario, to any policy which permits the exportation of electrical energy required for use in Canada.

As never before, the public interest has been aroused respecting both its fuel supply and its increasing dependence upon hydro-electric energy. The central portion of Canada depends upon the United States for its coal, and war conditions are driving home to Canadians the tremendous gravity of their position. The extent to which electrical energy will be available for heating has been much over-rated. Where large blocks of power are available at low rates, some will doubtless be so used. The availability of such power accounts for the establishment of large electrochemical industries at Niagara and other centres, but when the demand for power for municipal and small manufacturing purposes becomes more urgent, such works will probably be forced to leave present sites. Manufacturers and others who are ready to pay from 50 to 100 dols. per electrical horse-power year will not readily submit to industries utilising the coveted power at rates of from 10 to 20 dols. per horse-power.

The low-water power of the international portion of the St. Lawrence River is estimated at about 800,000 H.P., of which Canada is entitled to one-half. The estimated low-water power on the portion of the river which lies wholly within Canada would be about 1,400,000 H.P. This makes an estimated total for Canada of 1,800,000 continuous H.P.

The Hydro-Electric Power Commission of Ontario, by taking into consideration the diversity factor, can, with a power capacity of 250,000 H.P., supply contract requirements of 320,000 H.P.; therefore, assuming such a basis for the St. Lawrence River powers, Canada's 1,800,000 H.P. would take care of a power demand of some 2,400,000 H.P.

The 65,000 H.P. now being exported to the United States from the Cedars would, if retained in Canada, supply, at cheap rates, all the lighting and power required by a manufacturing city of 300,000 inhabitants. If distributed to Canadian municipalities, it would supply light and power to some 35 manufacturing cities of 10,000 inhabitants each. A comparison of the benefits resulting from power thus widely distributed, with the localised benefits from the same power utilised in bulk, as in the electrochemical industries, demonstrates that the former contributes in a much greater degree to the upbuilding of communities and to the growth of the country at large.

In a second report the Consulting Engineer deals with the power shortage in the portion of South-Western Ontario which is served from the Niagara Falls. The growth of the system directed by the Hydro-Electric Power Commission of Ontario is described. The yearly loads of the municipalities supplied have risen from 8,000 H.P. in 1910 to 250,000 H.P. (estimated) for 1918. The present available supply of power for the 200 municipalities served by the Commission is exhausted, and the shortage is acute. In October, 1917, the Secretary of the Commission sent an official notice to municipalities advising that no further contracts be entered into for a supply of power, nor for an increase in the load of the present power users.

Undoubtedly, much power and light is absolutely wasted. Not very long ago the vendors of electrical energy were offering special inducements to encourage consumption, and customers were invited to use new electrical devices as rapidly as such could be invented. The public has responded to these invitations, and now, assuming that there is no setback to industrial activity, Ontario is faced with a power shortage which, until relieved, must constitute a serious check to her industrial growth. The time is at hand when drastic action must be taken to curtail the use of electrical energy now employed on luxuries, and thus make it available for necessary purposes.

The Hydro-Electric Power Commission of Ontario is moving as rapidly as possible to have additional equipment, including pipe-line, installed, so as to have available in about 10 months an additional 50,000 H.P. from the plant of the Ontario Power Co.

The new Chippawa project which the Hydro-Electric Commission has started will, with the surplus water available, provide about 200,000 H.P., but cannot be available for approximately three years. The proposed size of the individual units, namely, 50,000 H.P., is larger than in any other hydraulic development in the world. Considerations of efficiency and desirable operating characteristics which it would be impossible to obtain with smaller units have prompted the adoption of such large units. Power is to be produced at considerably lower cost than 9.00 dols. per H.P. per year, which the Commission has been paying the Ontario Power Co. for the 100,000 H.P. covered by the original contract.

As the Hydro-Electric Power Commission of Ontario now controls the Ontario Power Co., the unused water allotted to the Ontario Power Co. will be diverted to augment the water supply available for the Chippawa project. If so, the capacity of the new Chippawa plant will be about 300,000 H.P.

Preliminary work upon this project, embracing surveys and other engineering activities, has been carried on during the last three years. Plant equipment and tools for carrying out the work of construction were purchased some time ago, and much of this equipment is on the ground ready for operation.

Details are given of the capacity of the large power plant in Canada at Niagara Falls, and it is shown that the shortage a year ago of power for present customers and firm contracts was 69,500 H.P. The total power generated on the United States side of the Falls is 265,000 H.P., and on the Canadian side 388,500 H.P. Since Canada exports 125,000 H.P. to the United States, the power used by the two countries is: United States, 390,000 H.P.; Canada, 263,000 H.P. If the power were equally divided, Canada would have 63,250 H.P. more than she retains at present.

In the course of a report on the heating of houses by coal and electricity, the Hydro-Electric Power Commission of Ontario points out that the climate of the greater part of the country is so severe in the winter that even the immense potentialities of its water powers, if fully developed, would be altogether inadequate to cope with the demand for power for electric heating if this were fostered to any considerable extent.

The difficulties in the way of utilising electrical energy for

the purpose are: (*a*) The enormous amount of energy that would be required, and which could be more efficiently applied to other purposes; (*b*) the high cost of electrical energy for heating as compared with other sources of heat energy.

For example, there are about 80,000 homes in the city of Toronto; if each of these is to be heated, and a demand of, say, only 12 H.P. per home must be met (probably a very conservative figure as an average for large and small homes), no less than 960,000 H.P. must be supplied for heating homes alone.

The 6,000,000 H.P. which represents the estimated total possible development of Ontario water powers is not sufficient to supply merely the existing *homes* of Ontario with electrical energy for heating alone, exclusive of all other domestic, commercial, and industrial requirements.

All the heating is required in the winter only, and assuming that a maximum demand of 1,000,000 H.P. had to be met for supplying a city like Toronto, the load on the plant required for this purpose, throughout the summer months, would be practically nothing. In other words, for five months every year this enormous plant would be idle. Suggestions have been made that use might be made of it to supply certain industries which could be operated mainly during the summer months, but here there are two difficulties: (1) What are the industries on a large enough scale to be of any use? (2) How could such enormous undertakings afford to lie idle during the winter months when power was unavailable? The situation in this case would be just about as bad for the industries in the winter as for the electrical stations, without the industries, in the summer.

Figures and statements such as the foregoing, which are based on incontrovertible facts, should once and for all answer the question in the negative as to whether the great water powers of Canada will ever entirely solve the fuel problem in a climate such as that of Ontario and Quebec.

The Commission sums up as follows:—

It can be readily demonstrated that, of the total energy in fuels, under the most favourable conditions a maximum of 12 to 15 per cent. is obtainable in the form of mechanical power; this is only about one-third of the percentage obtainable in the form of heat in the average house furnace. This fact leads to the conclusion *that, so far as is practicable*, fuels should be used for heating, and electrical energy for mechanical power.

True conservation, therefore, lies in using, to the fullest practicable extent, water power for the generation of mechanical power and fuels for heating. Where no water power is available, then the fuels must, of necessity, be used for mechanical power purposes, but this will preferably be done in large electrical generating stations, the electrical energy from which will be converted into mechanical power by means of electric motors, and again the fuels should preferably be used directly for the purposes of heating without converting their energy first into electricity and then into heat.—*Board of Trade Journal.*

WIRELESS DEVELOPMENT DURING THE WAR.*

Major-General G. O. Squire, chief signal officer of the U.S.A. Army, reviewing in a recent address before the A.I.E.E. the development of military aeronautics in the U.S. up to the armistice, said that in the question of the engineering achievements of the Signal Corps during the war, the development of wireless apparatus formed a large part, in which the vacuum tube occupied a prominent *rôle*. In his opinion the application to wireless intercommunication of the vacuum tube is one of the most interesting developments in the whole field of applied science. For not only has it made possible what has been justly heralded as one of the most spectacular achievements of the whole war—the airplane radiophone—but the confidence growing out of the extensive experience with the vacuum tube in warfare, coupled with its extreme adaptability, has resulted in a rapidly increasing amount of wireless development involving its use.

In addition to acting as detectors and amplifiers, vacuum tubes can function as oscillators, in properly designed circuits containing inductance and capacity they will act as high-frequency generators, for use in transmitting or receiving wireless signals; and as modulators, by suitable connection to an oscillator circuit or antenna, they can be made to vary the power radiated so that the envelopes of the waves transmitted shall have any desired wave form, as, for example, the speech waves from an ordinary telephone transmitter.

When the United States entered the war, vacuum tubes already were in use by the Allied forces for various signalling purposes. The French particularly had been quick to recognise the military value of vacuum tubes, and had, previous to June, 1917, developed very creditable tubes and apparatus. In America the total production, however, did not exceed three or four hundred a week.

Early in the American participation in the war, it became evident that vacuum tubes would be required in very large quantities. Service conditions would require great mechanical strength, freedom from disturbance under extreme vibration, and uniformity of product sufficient to make possible absolute interchangeability of the tubes in sets, without the necessity of readjusting when changing tubes, also that minimum of size consistent with dependable operation.

To turn out tubes by the thousand by factory methods involves great difficulties. Recently the total rate of production in the United States of high quality standardised tubes was considerably in excess of one million a year. This rate of production could be made many times greater on short notice.

The degree of vacuum required is such that unusual methods of exhausting are necessary. The heating of the tubes in electric ovens is supplemented by heating of the elements of the tube by excessive filament and plate electrical power input. Molecular pumps are employed, necessitating an extremely large number of pumps to handle quantity production. Special treatment of metal parts prior to assembly is employed to reduce the gas given off by them during the exhausting process.

Another problem is that of making the complicated metallic structure of all tubes exactly alike, in order to insure identical electrical properties. One company is prepared to manufacture, in quantity, a certain tube in which the clearance between filament and grid is only three-hundredths of an inch, the allowable variation being, of course, only a small percentage of this.

Tubes developed may be divided into two general classes: the tungsten filament types as developed and manufactured by the General Electric Co., and the De Forest Radio Telephone & Telegraph Co., and the coated filament or Wehnelt cathode types as developed and manufactured by the Western Electric Co. The coated filament tubes so far have proven superior to the tungsten filament tubes for Signal Corps use. Both classes have been standardised as regards base, exterior dimensions, filament current and voltage, and in addition, plate voltage and output for transmitting tubes; and amplifying power and detecting power for receiving tubes. Except in certain special cases, the Signal Corps uses two types of tubes, one for transmitting, and another for receiving. The French and the British have been using one type for both transmitting and receiving, but present tendencies of the British are toward different tubes for different duties.

Vacuum tubes are now employed for electric wave detection, frequency amplification, telephony, continuous wave telegraphy, voltage and current regulators on generators, and for other miscellaneous purposes.

Prior to April, 1917, a few experiments had been made, in which speech had been transmitted from airplane to ground by wireless methods; but the apparatus involved was hopelessly crude. The services of the Western Electric Co.'s engineers were enlisted, and under the direction of the Signal Corps, rapid development resulted in successful tests as early as August, 1917. Speech was exchanged between airplanes 25 miles apart in October, and sample sets were sent at once to the Army in France for trial. Several thousand sets were ordered and have been completed and distributed to flying fields in America and to the Air Service in France.

The satisfactory performance of this apparatus has resulted in a new type of military unit known as a voice-commanded squadron. The commander of an air fleet directs the movements of the individual units in any manner desired.

Other uses are in communicating information from airplanes to ground stations, and in directing one or more airplanes from a ground station.

An essential element of the airplane radiophone is the power equipment, which includes a double-voltage D.C. generator driven by an air fan, with a vacuum-tube voltage regulator. The equipment consists of the vacuum tube transmitting and receiving set, and the special telephone transmitters and receivers. The development of a transmitter which is affected by the human voice, and not by the enormously greater engine and wind noises, is one of the principal features of this set. Similarly, to shield the ears of the aviator from the same noises required a special combination of sound-insulating materials surrounding the telephone receivers and suitable for use within an aviator's helmet.

The antenna originally consisted of a flexible copper wire several hundred feet long, unreeled by the aviator and trailing almost horizontally behind the airplane. Modified antennæ using much shorted wires fixed to the framework are now used.

The operation of the sets is extremely simple, all adjustments being made before leaving the ground. The only manipulation required of the aviator is that of the change-over switch to change from talking to listening.

The Signal Corps developed a self-contained set, which consists of three units—the 200-watt, 900-cycle alternator, driven by a regulating air fan, and containing in a stream line case attached to the generator, all the elements of the set. This apparatus is of the synchronous spark type, with four spark tones and nine wave lengths. The weight of

*Proceedings of the American Institute of Electrical Engineers, February, 1919. Abstract.

the complete unit is 23 lb., and size only 6 in. by 6 in. by 26 in. The regulating air fan maintains the speed of the generator within 4 per cent. of 4,500 R.P.M., with air velocities between 60 and 200 miles an hour.

The remaining units in the complete set are a tuning coil, with antenna ammeter attached, and the antenna system, comprising a reel, insulated bushing, and trailing antenna. Voltages of 30,000 or more are produced, and ranges of communication of 100 miles have been accomplished with this set.

The use of directional effects of loops or coils for receiving wireless signals has resulted in the development of a wireless compass for airplanes which gives positive information to the aerial navigator, and enables him either to locate his position by triangulation with respect to two beacon land stations, or to fly at any given angle with respect to a certain beacon station.

The apparatus consists of two principal parts—the antenna coils and the tuning and amplifying apparatus. The antenna coils are mounted in the fuselage of the Handley-Page airplane, with suitable means for rotating in azimuth. The amplifier is extremely sensitive, consisting of a detector and six-stage amplifier. A novel feature of the amplifier is the use of iron-core transformers for frequencies of 100,000 cycles.

The direction of the beacon land station is determined by maximum strength of signals, in a highly ingenious manner developed originally by the British. The precision of the directional effect is remarkable.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Telephone and Telegraph Line Construction.

I think engineers generally will consider our practice of telephone and telegraph line construction a disgrace to the country. Every time we have any severe weather there is the same old trouble—lines down and exasperating delay. The usual excuse given is that it is due to the snowstorm or some other similar cause, which is no excuse. It was the same before the war.

Do the Post Office engineers realise that this country is not Florida or Bermuda, and that lines put up in this country should be installed for the climate and conditions in this country? The overhead lines of power companies seldom give way, and it is just as important that the telephone and telegraph lines should likewise be immune in this respect.

To make matters worse, when a section is down it is put up again in the same manner, and naturally with the same result next time the inclement weather repeats itself. Could anything be more futile?

I think we should be interested to hear from the Post Office engineers what steps they propose to take to remedy the present state of affairs. I hope it is not that because they are Government officials with assured jobs they are content to leave matters as at present.

In view of the vital importance of telephones and telegraphs for carrying on business, the yearly national loss if it could be computed would be an eye-opener. Spending money on repairing lines damaged by heavy weather is like throwing money away, as this can be avoided by putting up suitable lines in the first place. **G. F. S.**

Manchester, *April 10th*, 1919.

Tax the Bachelor—of Science.

Of course the bachelor should be taxed. Look at the salary he is offered in the "Situations Vacant" Column of a recent issue of the ELECTRICAL REVIEW.

A 'Varsity man with a degree and a certain amount of practical experience is eligible, at the age of about 25, to become a Chief Lecturer in Electrical Engineering in London at—£3 per week.

With such annual increments, too, that in 20 years, say when he is 45, he could be drawing £400 per annum. If he be not, therefore, severely taxed for being a bachelor, he might have the temerity to start saving at this age, and even to rush into marriage at 50.

And if he had insured his life heavily enough, and had the grace to die at the right time, his son, even, might think of going to a 'Varsity—one of the meanest and cheapest, of course, say the one in which his father had been Chief Lecturer in Electrical Engineering. Perhaps! **B.Sc.**

April 12th, 1919.

The City and Guilds Technological Examinations.

As a student in the first year's course of electrical engineering preparing for the above examination, I would like to state that I think that the preliminary examinations are a great encouragement to beginners, especially as many students never reach the final stage. However, if a student fails in the final examination now, he has at least the credit of having passed the previous ones, a fact which may prove of great value to him. **F. E. Rowland.**

London, N.W., *April 11th*, 1919.

BUSINESS NOTES.

Letters from the Forces.—"Major" writes:—"I still belong to H.M.S. ———, and am awaiting further instructions as to where I may be sent, and I take this opportunity of again thanking you for so regularly sending me the ELECTRICAL REVIEW. It has always reached me safely, and it has been most useful in keeping me in touch with my profession. It has been the only really reliable 'connecting link' which I could always depend upon for any information of the electrical world during the war, and during my 3½ years in the Orkneys, and I join with the many electrical engineers who have also availed themselves of your kind offer, in expressing my most grateful thanks."

German Dependency on Foreign Minerals.—The *D.A.Z.* (February 25th) contains a summary of an address delivered by Prof. Beyschlag at a meeting of the Berlin District Association of German Engineers, on the extent of Germany's dependence on foreign countries for her minerals after the war. The Professor divided the minerals requisite for German industry into three groups, the first containing minerals not found in Germany, or only found in insufficient quantities, the second containing minerals which are found in abundance but not yet in sufficient quantity to meet the demands of industries, and which must in part be imported; and the third containing minerals found in such quantities that after these demands have been met export is possible. To the first group belong the precious metals, white tin, and metals needed for admixture with steel, *e.g.*, nickel, chrome, wolfram, molybdenum, and vanadium, have to be imported. Tin comes mainly from the Malay States and Bolivia; this latter country supplied Germany before the war, but now the United States have become its chief customer. Germany obtained nickel from Canada and New Caledonia. Besides the metals mentioned there is also a lack of the important quicksilver, which was imported from Spain and Tuscany. Graphite, sulphur, phosphorus, lead, zinc, manganese, iron, and copper are found in Germany, but in comparatively small quantities. Before the war Germany produced 10 per cent. of her copper requirements, and after the war one-third of these requirements may find a substitute in aluminium, which Germany has learnt to produce within the country, the rest being covered presumably by surplus production in the United States. German iron ore, which is frequently of a poor quality, may well be exhausted in between 45 and 60 years. On the other hand, France, by the acquisition of Lorraine, will become the richest in iron ore of the European countries, and in the end will be obliged to export to Germany. Germany has abundance of potash salts, even if she has lost her world monopoly by the French acquisition of Alsace. There are also large quantities of coal and lignite, which are, however, endangered by Polish annexation claims in Upper Silesia and by those of France in the Saar district. Germany is also rich in aluminium produced from clay by an electrical process, and in electrically-produced nitrogen, while she has learnt how to win oils from coal and lignite and bituminous schist. The Professor was of opinion that by untiring labours Germany might again be partially independent of foreign countries.

Trade Publications for Durban Library.—The Borough librarian of the Durban Municipal Library desires to receive trade publications from the United Kingdom for display in the reading rooms. Over 1,000 people visit the reading rooms daily, and a selection of British commercial publications should prove an excellent advertising medium. Several orders, he states, have been known to have gone to some of our competitors through the presence of the latter's publication in the reading rooms. Publishers of United Kingdom trade and technical papers wishing to avail themselves of this opportunity should write to the Borough Librarian, Municipal Library, Durban, Natal.—*Board of Trade Journal.*

Industrial Paralysis of Germany.—Mr. Wilfred Hill, on his return from a visit paid to German territory in Allied occupation at the request of the War Office, was interviewed by the *Birmingham Post*, and in the course of his remarks he said: "I interviewed many Germans, and they told me their chief desire was to obtain sufficient supplies of food and to get settled again into normal ways of life. I visited some of the big German factories, and was profoundly impressed by their wonderful equipment, organisation, and efficiency. The aniline dye works, at Leverkausen, which I saw, employ in normal times, 20,000 people, although at present the number is about 10,000. We have nothing approaching the area of these works in this country. Factories stretch in one direction for a mile and a quarter, and they are all under the same control. As regards the future of German industry, I formed the opinion that we have little to fear from it for the next twelve or eighteen months. There is in Germany on the one hand an almost complete absence of important raw materials, and on the other, there is considerably more uncertainty about the labour question than in this country, whilst the heavy taxation and general shortage will bring about a high cost of living for a considerable time to come. That fact will have a profound effect upon the cost of production generally. The moral I saw in the situation was that we should lose no time in taking advantage of the temporary paralysis of Germany; that we

should bring our own methods of production thoroughly up-to-date and get ourselves well-established in the markets of the world whilst we have them at our disposal." Mr. Hill did not think that Germany would ever give this country such a hard run in the commercial race as formerly, even when her industries were revived. England was now in a much better condition to cope with her competition than before the war. He believed that Germany, by hard work, could pay the cost of the war and indemnities—"and they will work hard," he added.

A State of Paralysis in England.—In the course of a speech, delivered in the capacity of chairman of Cammell, Laird & Co., Ltd., Mr. W. L. Hichens said that in the business world one of the worst results of the present discontent was a paralysing uncertainty which hampered all activities. We were losing trade in foreign markets at a time when every effort ought to be made to increase it. We did not know what the cost of anything would be a few months ahead, and it was difficult, if not impossible, to make a firm quotation. Stability for a definite period was essential if we were to do business, and if we were to make the money out of which wages were paid. The agitators who made it their business to create an atmosphere of instability and flux were doing the greatest dis-service to those whose cause they claimed to champion, for they were attempting to destroy the conditions which made organised existence possible. There was no doubt we were being under-sold in many directions, and the course of events tended to weaken rather than strengthen our position in the markets of the world. In view of the widespread interest attaching to the problem of the relations between Capital and Labour, it might be useful to take the operations of the company in 1918 as a concrete instance and consider how far the results justified the oft-repeated complaint that capital got too much and labour too little of the profits of industry. The distributed profits amounted to £176,028, less than 5 per cent. of the total wages and salaries bill of the year. In other words, if capital had received no profit at all it would have been possible to pay another shilling in the pound to the wage-earners and the salaried staff. If a recognised system of profit-sharing had been adopted by the firm, and the balance, after providing 5 per cent. on the capital, had been divided equally between labour and capital, labour's share would have been £29,000, which was equivalent to about 16s. per cent., or barely 2d. in the pound on the wages and salaries bill. It must not be forgotten that it was the possession of capital which enabled the firm to find employment for so many workers, and if it were jeopardised, the employment of the workers would necessarily be jeopardised also. He did not think the game was worth the candle when the price was 2d. in the pound, or at most 1s. in the pound, if the stakes were wholesale unemployment.

Swiss Exhibition.—The Swiss Trade Exhibition will be held at Basle from April 24th until May 8th. This year the number of exhibitors has increased to 1,300 firms. In 1917 business to the amount of 20 to 25 million francs was done; last year that amount was doubled. Between two and three hundred thousand visitors attended the first and second exhibitions, and the number of buyers last year was 18,000. The exhibition aims not only at an increase of the Swiss home trade, but also at an extending of the Swiss exports. The goods offered are purely Swiss, and a strict control is stated to exclude all foreign products from participation. The general public are admitted two days in the week, according to the principle: "The exhibition is a means of communication to connect buyers and exhibitors." According to the *Board of Trade Journal*, the goods offered are divided into 19 groups, including the following: Heating, light, and sanitary fittings; technical articles in metal, wood, glass, cork, leather, india-rubber, &c.; machinery and tools; fine mechanical instruments, instruments and apparatus; electrical industry; sundries.

Iron and Steel Stocks.—Withdrawal of Control.—The Minister of Munitions desires to draw the attention of all concerned to the order made by him on January 7th, 1919, known as the Steel and Iron (Purchase and Returns) Order, 1919. It may be explained that during the war, part of the cost of production of iron and steel was met by direct subsidy from the Government. The subsidies in connection with the manufacture of pig iron have been continued to April 30th, 1919, and in consequence the prices of pig iron (as well as of manufactured iron and steel made therefrom) have been restricted to prices below the economic level. After the withdrawal of subsidies at April 30th, the entire cost of manufacture will have to be met by the iron and steel makers. It was explained in the Ministry notice published on December 2nd, 1918, that steps would be taken to prevent any hoarding of subsidised material during the period for which the subsidies were continued. For this purpose the above-mentioned order was passed. It provides in effect that no person is entitled to increase his stock of iron and/or steel by more than 100 tons except under a permit from the Ministry, and that such permits should only be granted on condition that the holders should repay to the Ministry a drawback (representing the subsidies paid on the material by the Ministry) in respect of all such stock which may be held by them on April 30th, 1919, exceeding by more than 100 tons the amount of stock held by them on October 31st, 1915, or October 31st, 1918, whichever is the greater. The drawback referred to, which has been fixed at 30s. per ton in respect of iron and/or steel, is a refund to the Government of the subsidies paid by it in respect of material which has not at that date been incorporated in any structure or plant or work in progress. The order further requires all persons who on April 30th, 1919, hold a stock of iron and steel, or either of them, of 100 tons or more to furnish to the Controller of Iron and Steel Production within fourteen days after April 30th, 1919, a true and complete return of the stock of iron and steel held by them (*a*) on October 31st, 1915, or October 31st, 1918, whichever shall be the greater; and (*b*) on April 30th, 1919. Forms of return for the purpose of the order may be obtained on application to the Controller, Iron and Steel Department, Ministry of Munitions, Whitehall Place, S.W.1. The Minister of Munitions desires to point out that the order applies to all persons whether iron and steel makers, merchants, stockholders, engineers, shipbuilders or other users of iron and steel, who hold over 100 tons of iron and/or steel on April 30th next. Instructions as to the classes of iron and steel to be included will be found on the return form referred to. It should be added that this return is called for under the powers conferred on the Minister of Munitions by the Defence of the Realm Act and Regulations, and any person failing to comply with the order is liable to the penalties provided under the Act.

The Trade Outlook in Argentina.—In the course of an article on "British Trade Interests in Argentina" appearing in the Peace Issue of the *Review of the River Platz*, Mr. H. O. Chalkley, commercial secretary, H.B.M. Legation, Buenos Aires, says that British capital has been invested in Argentine industries as follows:—

Tramways, £27,418,938.
Telephones and telegraphs, £3,196,926.
Electric light and power, £2,720,520.

The writer says that the place of the United Kingdom as the source of the capital which was regularly invested in Argentina before the war has not been taken by any other country nor has there been any decided tendency to finance undertakings locally. In consequence, railway construction, public works, port works, dredging and other development schemes have been suspended. This cessation of foreign capital investment must be regarded as an important factor in the reduction of the Argentine import trade, indicating the prospect of a notable increase in that trade, if and when such capital advances to the republic are renewed. On the other hand, new factors have arisen in this country, which may well retard foreign investments. During the last two years there have been constant labour troubles, and it is certain there are more to come in the future. The situation has been made more difficult by outbreaks of sabotage and attacks on property for which no adequate remedy or form of reparation has been found. The rate of interest which will be required to attract foreign capital to investments in Argentina will undoubtedly be higher owing to uncertainty as to the effects of these conditions. Mr. Chalkley adds:—

"The outlook for the prosperity of Argentina cannot be otherwise than favourable. The immediate effects of the cessation of hostilities might be summed up as a suspension of business in the import trade and uncertainty with regard to exports, but these effects are temporary and cannot affect for long the basic conditions which point to an assured prosperity. The expansion of the Argentine import trade, which is one in which British manufacturers are specially interested, may be counted on so long as purchasing markets and means of transport are found for the export of Argentine products. British manufacturers may view their prospects of trade with Argentina with confidence, and it would be an opportune moment to abandon the British habit of unfounded self-depreciation which was indulged in before the war. The high reputation which they held has if anything been increased by experience during the war, and they have only to quote competitive prices for the right article to be assured of preferential treatment by the Argentine importer. In greater adaptability to local tastes and requirements and reliability and quality British manufacturers can hold their own in the Argentine market; what has to be studied is more systematic methods of distribution, including a closer personal knowledge of the country. In addition, it may be said that no subject is more important for the future of British trade with the River Plate than the provision of adequate transport arrangements unencumbered if possible by the handicap of deferred rebates, a system that before the war drove much trade to the continent which would otherwise have fallen to the share of British manufacturers."

Bankruptcy Proceedings.—Louis Alfred Thomsom, who had traded at 59, Victoria Street, Westminster, as an electrical engineer, under the style of Saville & Walton. An application for an order of discharge was made on April 8th to Mr. Registrar Mellor at the London Bankruptcy Court. Mr. J. B. Knight, Official Receiver, reported that the applicant failed in November, 1915, with provable claims £2,547 and assets valued at £135, but which had only realised £6, the chief items being book debts, which proved to be irrecoverable. Having served with the Imperial Yeomanry in South Africa, and been for nine years in the employ of Messrs. Siemens Bros., Ltd., electrical engineers, the bankrupt in 1910 commenced a similar business without capital,

in partnership with Nield at Bream's Buildings, Chancery Lane, W.C., under the style of "Saville & Walton." For the purposes of the business the applicant borrowed £1,000 of his father-in-law, and Nield £200 of his mother. The business was considerable and necessitated them resigning their positions with Messrs. Siemens Bros., Ltd., which they had at first continued to hold. Branch businesses were opened at Cardiff and Cobham; thereafter there was a loss, and in October, 1913, the partnership was dissolved on accounts showing a deficiency of £550, Nield retiring on his mother being paid £100. In 1913 the bankrupt removed to 39, Victoria Street; the business was considerably restricted owing to trade disputes; in August, 1914, he again enlisted, and subsequently obtained a commission in the R.F.A., in which at the date of the receiving order, he held the rank of captain. His manager continued the business, which was ultimately closed in May, 1915, and these bankruptcy proceedings followed on the petition of a creditor. The bankrupt attributed his failure and insolvency to loss by carrying on the business between October, 1913, and May, 1915; and to loss on a speculation in linseed oil. As offences, the Official Receiver reported (1) insufficiency of assets to equal 10s. in the £ on the amount of the unsecured liabilities; (2) trading with knowledge of insolvency; and (3) contributing to the bankruptcy by rash and hazardous speculations. The applicant intimated that he wished to obtain an immediate discharge subject to a judgment, and his Honour adjourned the hearing until May 6th.

Edward Sidney Steel.—A further sitting of the London Bankruptcy Court was held for this public examination under the receiving order made in April, 1916, against Steel Bros., electrical engineers, 206, East India Dock Road, E. The debtor stated when he first attended under the proceedings that he never had a partner. He commenced the business in October, 1914, and carried it on successfully until the end of 1915, when as he had to join up he made arrangements to dispose of it. A statement of affairs was lodged showing liabilities £580 and assets £80, represented by shares in Steel's Electric & Engineering Co. The Official Receiver reported that the debtor was stated to have gone overseas, and it would be futile to further adjourn his public examination. The sitting was accordingly adjourned *sine die*, with liberty to the Official Receiver or the debtor to apply for it to be reinstated in the list when the debtor was able to attend the Court.

F. J. Earle, electrician, 3, St. Nicholas Road, Truro.—Receiving order made April 9th on creditor's petition.

German Ebonite Substitute.—The Hornite Works Joint-Stock Co. has been recently founded at Düsseldorf, with a capital of M. 300,000. Hornite is an ebonite substitute prepared from industrial residues, which in appearance and wearing qualities not only replaces ebonite, but will, it is said, owing to its extraordinary cheapness and special qualities, drive it off the market. Hornite will be used for door handles, window pushes, walking-sticks, telephone installations, cycle handle-bar grips, and various technical or surgical purposes.—*Kölnische Zeitung*, March 7th.

German Wire Prices Advanced.—The Rolled Wire Association raised the price of rolled wire by M. 100 per ton in February. The Union of Wire Works recently called a meeting of members, at which the prices for wire products were to be raised in conformity with the increased rolled wire prices. In the meantime, the prices of all wire products were advanced by the same amount as the rolled wire price, viz., by M. 100 per ton.—*Kölnische Zeitung*.

Where the Huns Destroyed.—The works of the Thomson-Houston Co., at Lesquin-les-Lille, which gave employment to 1,000 people, were destroyed by the Huns. Of the two large buildings comprising the works, one was taken down and carried off to Germany early in 1918, while the other, after being used by the enemy as an establishment for repairing war material, was set on fire by the Germans as they retreated in October last.

Iron and Steel Output.—The following statement as to production of iron in the United Kingdom is issued by the Ministry of Munitions:—

Pig Iron.

	Output during week ending Mar. 22nd, 1919. Tons.	Number of furnaces in blast.
Hematite	64,000	103
Basic	51,000	83
Foundry, forge, and other qualities	28,000	97
Ferro-alloys	5,000	12
Total	158,000	295

The Brazilian Industrial Delegation.—Mr. W. S. Barclay, of the Federation of British Industries, sailed on Saturday for South America, to act as a special Commissioner to conduct back to this country the Brazilian delegates who have been appointed by the Brazilian Government to undertake a tour in this country as the guests of the Federation. At the end of the present tour of these Brazilian delegates the Federation intends to send a permanent Commissioner to Brazil as part of its Overseas Commissioner Service.

New Electrical Companies in India.—Among the new electrical concerns recently formed in India, are the English Electrical Co., 6, Hastings Street, Calcutta—capital, 100,000 rupees; and the Metallic Filaments Co., 55, Basettipet, Bangalore City—capital, 100,000 rupees.

Catalogues Wanted.—The Warrington Electrical Co., Ltd., who have commenced business at 82, Sankey Street, Warrington, require lists of electrical accessories, switchgear motors, and other electrical apparatus.

Government Stores.—It is announced that Mr. W. J. Larke, O.B.E., Controller of the Disposal of Miscellaneous Stores, has removed from the Hotel Métropole to Caxton House, Westminster, headquarters of the Miscellaneous Stores Department.

Liquidation.—Electricity Supply Co. for Spain, Ltd.—Meeting, May 14th, at 38, Commercial Street, London, E., to hear an account of the winding-up from the liquidator.

Book Notices.—"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVIII. No. 3. March, 1919. New York: The Institute. Price $1.

"The Strowger Automatic Telephone Exchange." By R. Mordin. Pp. xii. + 186; 82 figs. Price 21s. net. "The Elements of Telephony." By A. Crotch. Second edition. Pp. 114; 57 figs. Price 2s. net. London: E. & F. N. Spon, Ltd.

Trade Announcements.—The Stuart Electrical Co., of Union Chambers, Temple Row, Birmingham, have commenced business as electrical engineers and contractors, with Mr. F. W. Twentyman, late of Messrs. Ellis & Ward, Ltd., of London and Birmingham, as manager. Catalogues and lists, with trade terms, are desired.

Mr. Bernard Meggitt, who has been demobilised, has taken over the control of the electrical business of the Progressive Engineering Co., Ltd., at his old address, Station Street, Mansfield.

Mr. G. H. Morland, discharged from the Forces, has commenced business as an electrical engineer at 22, West Street, Maidenhead.

Mr. Thos. Hall has commenced business as an electrical engineer at 4, New Road, Kenilworth.

The Allied (Sheffield) Iron and Steel Co., Ltd., of 18, Cadman Lane, Norfolk Street, Sheffield, have opened a branch to deal in motor-cars, lorries, tires, and electrical equipment, including dynamos, motors, switchgear, cables, lamps, and electrical accessories.

Mr. Joseph Marson, for 20 years with Mr. G. R. Marson, of Hales Street, Coventry, has commenced business as an electrical engineer and contractor at 17, Styvedale Avenue, Coventry.

The Lead Market.—In their report dated April 12th, Messrs. James Forster & Co. state:—"The 'Controllers' have again reduced the price of lead 20s. per ton, making it £25. We venture to say that the reductions made in the last fortnight have not been necessary, and have not resulted in the sale of more lead than would have taken place without the reductions. . . . Consumption at home, and export, is increasing, and is certain to increase, but, on the other hand, the stock—96,450 tons—restricts buying to prompt requirements, and consumers are very unlikely to depart from this course."

The report of Messrs. G. Cawson & Co., also dated April 12th, says:—"There has again been a good business done in all positions. The control price was reduced to £25, and this brought in quite a good trade—consumers buying freely to cover their requirements. . . . There is no doubt that prices have now come down to a reasonable level. Seeing the greatly increased cost of production, and the advance in coal and labour, it is quite certain that output will gradually show a considerable decline, and consumers are probably well advised in covering their forward requirements. The outlook continues favourable for a good trade, and as the Labour position is now more settled, and Peace apparently in sight, we look for a continued good demand."

Catalogues and Lists.—It may be understood, as a general rule, that copies of publications mentioned in this section may be obtained on application to the firm or company at the address given.

Messrs. Fullers, Chadwell Heath, Essex.—Illustrated price-list (4 pp.) of Fuller dry (square and round-type) batteries for P.O. telephone and railway work, and inert batteries for telegraph and telephone, gun-firing, and naval service.

Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, London.—Eight-page illustrated price-list, describing their Hart "M S L" batteries (6 and 12 volts) for motor-car electric starting and electric lighting. Spare parts are also tabulated very clearly.

Messrs. Donovan & Co., 47, Cornwall Street, Birmingham.—Forty-page fully illustrated and descriptive catalogue, giving particulars of their "Safuse" and "Donlok" Home Office switch and fuse gear for factory installation service. Prices are tabulated.

Cheap Steam, for March, 1919 (issued by Messrs. E. Bennis and Co., Ltd., of Little Hulton), is a very fine number. Not many technical publications are yet able to avail themselves so generously of art paper. There is a technical feast of more than 50 pages of editoral matter, including a finely-illustrated reprint from *Engineering* of a description by G. F. Zimmer of the coal-handing appliances at the Coventry electricity works, with large infolded drawings; also a full reprint of a paper and discussion on "Steam Engines and their Relation to the Fuel Economy Problem" (A. E. A. Edwards, at the Birmingham Association of Mechanical Engineers); the "Education for Genius" address (E. C. Reed) is continued, as is also "The Control and Measurement of Temperatures"; and some of Mr. A. W. Bennis's notes on "Fuel Economy" are extracted.

Reconstruction.—Pamphlet No. 20, issued by the Ministry of Reconstruction, deals with the subject of "Land Settlement."

L.C.C. Capital Expenditure.—It is no longer necessary for the London County Council to obtain the special consent of the Treasury to the incurring of capital expenditure, as the war restrictions have been withdrawn.

Works Extension.—Messrs. Marshall, Sons & Co., Ltd., have purchased a site at Gainsborough, upon which to extend their works.

Export Restrictions.—The *London Gazette* for April 11th contains particulars of amendments in and additions to export restrictions.

LIGHTING AND POWER NOTES.

Accrington.—Proposed Loan.—The T.C. has agreed to apply for sanction to borrow £85,000 for additional plant and mains in connection with the electricity undertaking.

Belfast.—Proposed New Power Station.—At the last monthly meeting of the T.C. it was reported that the tenders for the foundations of the new harbour generating station ranged from £120,000 to £170,000; it was estimated that the buildings would cost at least 50 per cent. more than the foundations, and that the total cost would be from £250,000 to £300,000. The original estimate of Sir John Snell was £46,000 for the buildings and foundations. Alderman Tyrrell said that the interest on the revised estimates for the complete scheme would be £60,000, instead of £27,500, and this would fall on the consumers. Agreements had been entered into with the two shipbuilding firms, and the only change that could be made in the charges for energy was that which depended on the price of coal. A special meeting of the Council is to be called to consider the matter.

Blackburn.—Proposed Loan.—The T.C. has approved of application being made to the L.G.B. for sanction to a loan of £250,000 for the proposed new generating station at Whitebirk.

Canada.—Strike.—The strike of the Montreal Light, Heat and Power Co.'s employés on Wednesday last week, for the recognition of their union has not resulted in the closing of the services as many of the employés are remaining on duty.

Cheriton.—E.L. Scheme.—The U.D.C. is supporting a petition to the Folkestone Electricity Supply Co. for terms for a supply of electricity for lighting in the district.

Cheltenham.—E.L. Scheme.—The T.C. has decided to apply to the L.G.B. for a loan of £26,000 for completing the lighting of the town by electricity. The Gas Co. had informed the Council that in future its charges would be £10 per lamp, and it was stated that a saving of £4 per lamp would by effected by adopting electric lighting.

Continental.—Germany.—The Provincial Landtag of Pomerania has decided to grant a subsidy of Mk.13·5 mill. for the overland power transmission system, which it is desired to make independent of coal by taking advantage of water power.—*D.A.Z.*

The Deutsche Wasserkraft Verband is the name of a new association which has lately been formed at Berlin with the object of encouraging the utilisation of the water-power resources of the country for the generation of electrical energy for power and other purposes.

Derby.—Price Increase.—The extra charges for electricity have been advanced by the T.C. from 40 to 60 per cent.

Doncaster.—Price Increase.—The price of electricity has been increased by the T.C. from 25 per cent. to 40 per cent. above the pre-war charges.

Dublin.—Electricity Charges.—The T.C. has decided that the 50 per cent. advance put on the price of electricity last October shall only continue in force during the June quarter.

Dartford.—Proposed Price Increase.—The U.D.C. has applied to the B. of T. for an order to increase the statutory maximum price of electricity for lighting by 50 per cent. Energy is to be supplied to the engineering works of J. & E. Hall, Ltd.

East Cowes.—Proposed Price Increase.—The U.D.C. has decided to oppose the application of the Isle of Wight E.L. Co. for power to increase its charges for electricity from 8d. to 9d. per unit.

Ellesmere Port.—Proposed Bulk Supply.—In view of Government action regarding the supply of electricity, the U.D.C. has deferred sanction to a supply of electricity in bulk to the Ship Canal Portland Cement Co. by the Mersey Power Co.

Folkestone.—E.L. Charges.—The T.C. has rejected a recommendation by the Electricity Charges Sub-Committee authorising, under the deed of transfer, an increase from 7d. to 7½d. per unit for electricity, on the application of the Electricity Supply Co. The B. of T. has sanctioned an increase to 8d., subject to the T.C. agreeing to alter the deed of transfer, which provides for a maximum charge of 7d.

Godalming.—Electricity Charges.—The Urban E.L. Co. has decided to enforce a minimum quarterly charge of 13s. 4d. for electricity supplied up to 20 units.

Hastings.—Price Increase.—The T.C. has decided to apply to the B. of T. for consent to increase the advance of 20 per cent. on pre-war charges for electricity to 50 per cent.

High Wycombe.—E.L. Charges.—The E.L. and P. Co has decided to charge a minimum of 13s. 4d. per quarter for energy consumed up to 20 units.

King's Lynn.—Proposed Loan.—The T.C. has decided to apply to the L.G.B. for sanction to a loan of £34,200 for extensions at the electricity works in connection with the supply of electricity to two shipyards at West Lynn.

Knottingley.—E.L. Order.—The U.D.C. has decided to proceed with negotiations for the transfer of its E.L. order to the Electrical Distribution of Yorkshire, Ltd.

Malvern.—Extensions.—The U.D.C. has decided to supply electricity for power and lighting to the works of the Morgan Motor Co., Ltd., which are outside its area.

Mitcham.—Mains Extensions.—The County of London E.S. Co. has informed the Council of its intention to lay cables in the town.

Portrush.—E.L. Scheme.—The U.D.C. has decided to proceed with an E.L. scheme, and to approach the Belfast Banking Corporation for a loan of £10,500 for the purpose.

Redcar.—E.L. Scheme.—The U.D.C. has appointed a deputation to interview the Cleveland and Durham E.P. Co. with regard to a supply of electricity in bulk for the lighting of the district.

Rochdale.—Proposed Loan.—The T.C. has decided to apply to the L.G.B. for sanction to a loan of £68,500 for extensions at the electricity works.

Stretford.—Price Increase.—The Electricity Committee has increased the charges for electricity from 65 per cent. to 80 per cent. over pre-war charges.

Torquay.—Year's Working.—The receipts of the T.C. electricity department for 1918 totalled £21,091, and the expenditure £23,234, leaving a net loss of £2,143.

Energy for Tramways.—It was stated at a meeting of the Council that the tramway company was being supplied with electricity at below cost price, and negotiations have been entered into for the charges to be increased.

Warwick.—Proposed New Station.—The Leicestershire and Warwickshire E.P. Co. has applied to the B. of T. for consent to erect a generating station at Emscote.

Watford.—Proposed Bulk Supply.—The North Metropolitan E.P.S. Co. has submitted revised terms to the U.D.C. for a supply of electricity in bulk.

Warrington.—Loan Sanction.—The T.C. has received consent to a loan of £11,011 for electricity purposes, and all applications for lighting installations are to be proceeded with. There are prospective demands for power to the extent of 10,760 H.P., and action with regard to these has been deferred pending an interview with the B. of T.

Worle.—E.L. Scheme.—The Weston-super-Mare E.L. Co. has been asked upon what terms it is willing to supply electricity to the parish for lighting and power.

TRAMWAY AND RAILWAY NOTES.

Barrow.—Municipal Purchase.—The T.C. has secured an extension of time to consider its option to purchase the British Electric Traction Co.'s system within its area.

Continental.—Italy.—A strike which took place at Rome, on Thursday, last week, included tramway men. The strike had no economical motive, being purely political, and ended the same evening. The leaders are under arrest.

Edinburgh.—Fare Revision.—The T.C. has decided to support the application of the Edinburgh and District Tramway Co. for B. of T. sanction to increase the tramway fares from 1d. to 1½d. per mile.

Halifax.—Price of Rails.—The Tramways Committee has decided to call the attention of the Municipal Tramways Association to the high price of tramway rails and materials, with a view to the Government being asked to fix a reasonable maximum price in connection therewith.

Heywood.—Year's Working.—The receipts of the Corporation tramway department for the past year totalled £6,795, an increase of £1,200; passengers carried numbered 17,525,190, an increase of 1,114,166, although the car-miles run were 98,306 less than in the previous year.

Huddersfield.—Sunday Service.—Differences between the Tramways Committee and its employés have been settled, and a complete day's rest per week is to be granted to every man as soon as sufficient staff can be obtained to make it possible; the Sunday service, which had been suspended, has been resumed.

London.—Accidents.—The breaking of an axle on a west-bound train between Blackfriars and Temple led to traffic dislocation, on Thursday morning last week, on the District Railway, as announced in our last issue. Trains going east at the time could not be run back and the line cleared for on-coming trains. Some passengers had to be conducted along the line to the nearest station.

Another mishap, which added to the disorganisation, was caused by a fire breaking out in the motor carriage of an Ealing-Southend train near Hammersmith Broadway Station about 9 a.m. The flames were quickly overcome, but trains running eastwards were for a time held up.

Owing to the burning out of a signal cable, there was some delay, on Friday, on the Metropolitan Railway.

The City and South London Railway Co. proposes to deposit a Bill which, although out of time, will be proceeded with this session. The Bill proposes to extend the time for the enlargement of the tunnels and other works authorised in 1913 and interrupted by the war, until August 15th, 1924. Powers are also sought to construct three new subways to relieve the traffic at Stockwell and Clapham Common Stations, and to borrow for the purposes of the undertaking by the creation of Redeemable Second Debenture Stock any sum not exceeding £1,500,000, carrying interest at the rate of 5 per cent. per annum.—*The Times.*

Owing to the breakdown of a tramcar on the South London L.C.C. tramway system on Thursday morning last week, all the tramcars were brought to a standstill for about 20 minutes.

L.C.C. Fares.—The L.C.C. Finance Committee has recommended that the L.C.C. tramway fares be increased from the present average of 1·8 miles per 1d. to 1·5 miles per 1d.

L.U.T. Fares.—The London United Tramways Co. states that from April 13th its ordinary fares will average 1d. for 1¼ miles, and about 1d. for three miles in the case of workmen's fares.

Newcastle-on-Tyne.—Sunday Service.—The Tees-side Committee of the Iron and Steel Trades' Confederation has asked its members to cease work on Sundays unless the tramway service is restored.

Northampton.—Power for Tramways.—The Tramways Committee is considering an offer of the Northampton E.L. and P. Co. to supply power for tramway purposes at 1¼d. per unit for 1,500,000 units per annum, or 1⅜d. for 1,250,000. During the year ended March, 1918, energy generated by the Corporation and consumed on the tramways, cost a little over 1¼d. per unit. It is estimated that the Corporation could save £4,000 per annum by closing down its generating station and taking all its supplies from the company.

Rochdale.—Year's Working.—During the past year the receipts of the Corporation tramway department amounted to £110,564, an average of 18·3d. per car-mile, against £102,205 in the preceding year.

Trade Union Amalgamation Ballot.—The ballot of the London and Provincial Union of Licensed Vehicle Workers, on the question of amalgamating with the Society of Tramway and Vehicle Workers, resulted as follows:—For, 17,498; against, 689. The figures of the Tramway and Vehicle Workers are not yet available.

United States.—Railway Electrification.—The U.S. Fuel Administration, which recommended the electrification of certain mountain sections of the Californian railways, as a war measure, has issued a report containing data regarding the conversion under peace-time conditions. The cost is estimated at $23,000,000. The power requirements would be about 267,000,000 units, and the maximum demand about 121,600 kw. The report states that over 20 per cent. of the production of coal and oil fuel in the U.S. is consumed by the railroads, and half of this is wasted by the inefficiencies of steam locomotion.

One-Man Tramcars.—The new type of one-man tramcars is now in use on 130 tramway undertakings throughout the U.S. The cars are extremely light, weighing from 12,000 to 15,000 lb. fully equipped, and seat 32 to 40 passengers. They are fitted with safety apparatus which shut off the power, bring the cars to an emergency stop, sand the track, and open doors at each end if the driver becomes incapacitated. It is claimed that, by the use of these cars, double the service can be maintained at the same expense.—*Journal of Electricity.*

Electric Railway Operation.—Preliminary figures of the quinquennial report on the electric railways of the States of Florida, Idaho, Wyoming, Connecticut, and Rhode Island have been issued by the Bureau of the Census, U.S. Department of Commerce. The statistics relate to the years ending December 31st, 1917, 1912, and 1907. The totals include electric-lighting plant operated in connection with electric railways, and not separable therefrom, but not mixed steam and electric railroads, or railways under construction.

The figures for Florida show that the number of companies was 8 in 1917, and 10 in 1912 and 1907; there were 183·03 miles of track in 1917, compared with 164·84 in 1912, and 118·26 in 1907. The income from all sources was $2,444,514 in 1917, compared with $1,969,315 in 1912, and $1,371,541 in 1817, and operating expenses increased from $956,860 in 1908 to $1,155,091 in 1912, and $1,387,107 in 1917. Taxes, interest, fixed charges, &c., increased from $186,222 in 1907, to $424,717 in 1912, and $516,556 in 1917. The net income was $540,851 in 1917, $389,507 in 1912, and $228,459 in 1917. The electrical power consumed in 1917 amounted to 32,073,156 units, and in 1912 to 25,529,043. Of this power, all but a small amount was generated by the companies.

The figures for Idaho and Wyoming show small gains in trackage, equipment, and income for the semi-decade 1912-1917, but they are far below the gains made during the period of 1907-1912. The operating companies in these two States numbered 6 in 1917, 5 in 1912, and 2 in 1907. There were 127·7 miles of single track in 1917 (Idaho 104·65, and Wyoming 23·05), compared with 111·84 miles in 1912 (Idaho 88·93, and Wyoming 22·91), and 44·24 miles in 1907, the latter being all in Idaho. Passengers carried in 1917 numbered 4,736,414, with a passenger revenue of $423,940, compared with 5,568,781 revenue passengers, and a revenue of $450,913 in 1912. The total income was $524,182 in 1917, compared with $519,153 in 1912, and operating expenses increased from $368,697 in 1912 to $375,858 in 1917. Taxes, interest, fixed charges, &c., amounted to $154,302 in 1912, and $132,786 in 1917.

The figures for Connecticut and Rhode Island show general gains for both the five-year periods, 1912-1917, and 1907-1912. The number of operating companies was 9 in 1917, 10 in 1912, and 15 in 1907. The mileage of single track in Connecticut in 1917 amounted to 1,080, an increase of 6·3 per cent., compared with 1912, and of 38·2 per cent., compared with 1907. The corresponding items for Rhode Island were 454 miles, 4·2 per cent. and 5·3 per cent. respectively. The number of passengers carried in 1917 was 319,931,011, compared with 266,385,229 in 1912, and 213,725,761 in 1907. The income from all sources was $18,614,261 in 1917, compared with $14,457,064 in 1912, and $11,838,033 in 1907, and operating expenses increased from $7,601,929 in 1907, to $9,090,782 in 1912, and 14,187,238 in 1917. Interest, taxes, fixed charges, &c., amounted to $3,693,440 in 1907, to $3,439,952 in 1912, and to £4,518,093 in 1917.—*B. of T. Journal.*

TELEGRAPH AND TELEPHONE NOTES.

Argentina.—A wireless concession for 30 years has been granted to the German Telefunken Co.

British Cable Censorship.—Lord Reading declares that there is no foundation for the complaints, reported from Paris, that the British censorship has been used to promote the interests of British trade at the expense of that of America.—*The Times.*

Cable Delays.—The time taken in the transmission of telegrams from abroad continues to show improvement, but the delays are still causing great inconvenience and loss. From particulars given in the *Times*, it will be noted that a telegram from Brussels took three days in transmission, while another from Berlin was received on the day after dispatch. Other Allied capitals, such as Bukarest and Belgrade, suffer even more than Brussels in this comparison with facilities granted to the enemy.

Telephone Installations.—The Post Office states that it is unable to effect fresh telephone installations at present, owing to the shortage of wire and skilled linemen.

Wireless Call Signals.—The Air Ministry states that as some confusion appears to exist with regard to the wireless call-signs allotted to aircraft for the trans-Atlantic flight, each machine has been given a group of three letters lying within the limits D K A to D M Z, which serves as a call-sign and as a rapid method of establishing the machine's identity. Thus D K A is the wireless call-sign of the Sopwith machine competing in the trans-Atlantic flight.

Wireless Operators.—A dispute has arisen between the Association of Wireless Telegraphists and the Shipping Federation regarding the payment of £3 per month war-risks bonus granted by the Shipping Controller in October last. The Association states that no payment has yet been made, and has decided that, unless the money is paid by noon on April 16th, no wireless operators will sail from British ports. Over 4,000 wireless operators of the mercantile marine are affected.

Wireless Telephony.—Mr. Ernest F. W. Alexanderson, consulting engineer of the American General Electric Co., announces, according to the evening Press, that his company is considering plans for a trans-Atlantic wireless system, to enable New York to converse with Paris and London. He says two devices, which make the plans practicable, are a bridge receiver and a barrage receiver, both being his own inventions. The bridge receiver permits continuous conversation as in ordinary telephony. Conversation on wireless telephones previously has been carried on in relays—that is, one man could not speak and listen at the same time. The barrage receiver permits the operator to centre his attention on the message in which he is interested.

The Royal Air Force is busy pursuing research work in wireless telephony in France; new apparatus is being put to practical use under test conditions in connection with the Folkestone-Cologne aerial mail service. Along this route a chain of call stations is being installed, and the machines are being fitted with both sending and receiving sets. As yet the idea has not passed the experimental stage.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Brisbane.—May 15th. Department of the Treasury. H.T. switchboard, storage battery and motor-generator set for the electric power house, Inkerman Irrigation Area, Townsville. Specifications from the Hydraulic Engineer, Brisbane.

June 18th. Brisbane City Electric Light Co. Supply of rotary converters (specification 10a. 6d.) from the offices of the company in Brisbane.—*Tenders.*

Melbourne.—May 14th. Victorian Railway Commissioners. Cells, renewals, caustic soda and mineral oil for caustic soda batteries. (Contract No. 32,194.)

Sydney.—June 9th. City Council. Supply and erection of power-house switchgear. Specifications from Electric Lighting Department, Town Hall, Sydney.*

Bedford.—May 3rd. Electricity Department. Meters for 12 months. (See this issue.)

Birr (King's County).—May 1st. Birr Electric Light and Power Co., Ltd. Hydraulic turbine and accessories, electric generator, reducer set and motor booster, switchboards, alterations to P. & G. storage battery, overhead distributing lines, wood poles and fittings. (April 11th.)

Dublin.—April 24th. Electricity Supply Committee. High-tension switchgear and alterations to existing switchgear. (April 11th.)

Dundalk.—April 29th. U.D.C. Electricity Department. Replating of storage battery. (April 11th.)

Edinburgh.—April 21st. School Board. Installation of electric light at London Street School. Mr. J. Stewart, S.S.C., Clerk to the Board, Castle Terrace.

Lancaster.—April 25th. Corporation tramway uniforms. (April 11th.)

London.—Battersea.—May 1st. Electricity Department. One water-tube boiler, superheater, economiser and mechanical stoker, induced-draught plant for main flues. (April 11th.)

L.C.C.—The Highways Committee recommends that tenders be invited for the supply of axle boxes, porcelains, track insulators, insulator clips, track insulator stems and refined tin ingot, required for use in the tramway department.

Tynemouth.—April 24th. Corporation. One 500-kw. rotary converter, with accessories. (April 11th.)

*A copy can be seen at the Inquiry Office of the Department of Overseas Trade (Development & Intelligence), London.

CLOSED.

Australia.—Commonwealth Department of Works and Railways. Electromedical apparatus for military hospitals.

Motor generator sets, £798.—G. Weymouth, prop.
Control panels, £155; wallboards, £604.—J. L. Newbiggin.
Faradic coils, £178.—E. A. Machin.
Milronom interrupters, £252.—V. Nightingall.
Radiant shoulder baths, £29; violet ray high frequency sets, £95.—W. Watson & Sons.—*Tenders.*

Bradford.—Corporation. Electricity Committee:—

Two "Venturi" meters for turbo-generators.—George Kent, Ltd.

Tramways—
Eight tons steel tie-bars, at £39 10s. per ton.—Bayliss, Jones and Bayliss, Limited.
1,000 copper rail bonds, £81.—B.I. and Helsby Cables, Ltd.
Materials for 600 Thermit welded joints, at 19s. 6d. per joint plus 25 per cent.—Thermit Welding Co., Ltd.
Three tons w.i. welded rings, one ton clips, and one ton bolts and nuts, £204.—E. Longbottom.
29 tons round mild steel rods, £659.—Crossley & Davenport.
800 tons high-silicon steel rails, at £18 12s. 6d. per ton (150 tons to be treated by the Sandberg sorbitic steel process, at 31s. per ton extra, including royalty and supervision during manufacture).—Walter Scott, Limited.

Dover.—T.C.:—

Tramway points and crossings.—Hadfields, Ltd., £90 per set.

Dartford.—U.D.C.:—

Switchboard extensions.—Johnson & Phillips, Ltd., £969.

Huddersfield.—The English Electric Co., Ltd., has received a contract from the Huddersfield Corporation for a 5,000-kw. turbo-alternator set, speed 3,000 r.p.m.

London.—L.C.C. Main Drainage Committee. Water softening plant at the Southern Outfall boiler house:—

Paterson Engineering Co., Ltd., Holborn, W.C.		£525
" " " " "	(alternative tender)	570
J. Wilson	(recommended)	**537**
United Water Softeners, Ltd.		576
" " " "	(alternative tender)	475
Bowes, Scott & Western		559
Bell Brothers		988

L.C.C.—The Highways Committee recommends that the Committee be authorised during the Easter recess to open any tenders, involving a capital expenditure of over £500, which may be received for the supply of materials, &c., for tramway purposes.

Reading.—T.C.:—

Motor chassis for the railway welding machine and for the tramway tower wagon.—British Automobile Traction Co., Ltd., £1,000.

Sunderland.—T.C.:—

C. C. Wakefield & Co., Ltd. and Ressoils, Ltd.—Turbine and cylinder oils to the Electricity and Lighting Department.

Wolverhampton.—T.C.:—

Motor shed for the electricity works, £541.—T. & S. Ham.
72 consumers' meters, various sizes, £409.—Chamberlain & Hookham, Ltd.

FORTHCOMING EVENTS.

Institution of Electrical Engineers.—Thursday, April 24th. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Paper on "The Fullerphone, and its Application to Military and Civil Telegraphy," by Major A. C. Fuller, R.E.

Society of Technical Engineers (North-Western District).—Friday, April 25th. At 7.15 p.m. At Milton Hall, 244, Deansgate, Manchester. District mass meeting.

Junior Institution of Engineers.—Friday, April 25th. At 7.30 p.m. At 39, Victoria Street, London, S.W. "Commercial Flying," by Mr. J. D. North (of Boulton & Paul, Ltd.).

NOTES.

Industrial Reconstruction Council.—At the Saddlers' Hall, on Wednesday, April 30th, a lecture on "The Aeroplane in Industrial Development," will be delivered by Mr. Holt Thomas.

Appointment Vacant.—Station superintendent (£250 to £300), for the Grays Thurrock U.D.C. Electricity Works. See our advertisement pages to-day.

Electrical Trades' Crisis in London.—The dispute between the National Federated Electrical Association and the Electrical Trades Union, London Branch, has assumed a serious aspect. The Union refuses to agree to an amicable settlement, and if the lockout takes place it is probable that a national strike will result.

An Electrically Welded Gondola Car.—Reference to what is believed to be the pioneer attempt at fabricating a steel freight car structure by the electric welding process is made in the *Railway Review*. As long ago as 1911, the American Car & Foundry Co. fabricated a steel, drop-bottom gondola car, as an experiment, by electric spot welding. At the time electric spot welding was by no means in common use, and the practical limit of commercial equipment then available was two 3/16 in. plates. It was therefore necessary to design a complete new apparatus. The company succeeded in building a machine capable of welding a ¼-in. core through plates assembled in thicknesses up to 2¼ in. The machine consisted of a structural steel frame with a 66-in. throat, having a recess for the accommodation of an 85-kw. transformer and arranged for 440-volt primary circuit and a 25-volt secondary circuit. The electrodes were of copper 3 in. in diameter with the welding points reduced to ¾ in. Regulation of the primary circuit was effected by means of taps in the primary winding to supplement which, a choke coil also was employed. Pressure was applied to the work through the medium of an air cylinder device. Owing to the inaccessibility of some of the connections and to the use of a considerable number of castings, as in the case of the door hinges, &c., only about 85 per cent. of the fabrication was effected by means of welding, rivets being resorted to for the remainder. In the underframe, welding was used on the centre sill and cross bracer cover plates and in the end sill and the body bolster assemblies. With the exception of the ladder irons, it not being desired to risk human life by attaching them by a process admittedly experimental, the entire superstructure was assembled by the spot welding process. It was estimated that at least one-third of the time otherwise required to put the car together had been saved, added to which was the saving in wear and tear on the tools and machinery ordinarily used in punching and reaming rivet holes, to say nothing of the wasted power entailed in the operation of these tools through the medium of compressed air and the expense involved in replacing broken drills and reamers and the maintenance of the compressed air machinery. A study of the work led to the conclusion that the actual power requirement by the new method of car fabrication had been reduced to about one-third of its former value. By way of testing the completed car, it was given a 150 per cent. load, under which it was shown to be a very rigid structure and developed no permanent set. In seven years' service the car had made a very creditable record—it being an experiment without precedent—and it still continues in everyday service.

Polyphase Commutator Machines.—When a polyphase commutator machine is connected in the rotor circuit of an induction motor—*e.g.*, as a Leblanc exciter or Kapp vibrator—it is found that the voltage at the terminals of the commutator machine does not agree with the calculated value, and, furthermore, if this voltage is measured with a voltmeter of the electro-dynamometer type with several ranges, the readings obtained on the different ranges of the voltmeter are not in concordance. These effects, according to an article in the *Bulletin* of the Société Française des Electriciens, are due to the presence of harmonics. The machine has the property of acting as a condenser as regards low-frequency currents, but as a reactance as regards higher harmonics. The high-frequency currents produced by the teeth cannot, therefore, penetrate the rotor windings, and the rotating flux is, in consequence, distorted so as to induce high-frequency electromotive forces in the stator windings. These may reach 2 to 3 per cent. of the stator voltage. This accounts for the departure of the stator voltage from the calculated value, and also for the inconsistency of the readings of the voltmeter, as the reactance of this voltmeter is appreciable in respect of the high-frequency currents that are produced. The article concludes with an interesting discussion of the phenomenon of self-excitation of polyphase commutator machines. The action is compared with the oscillation of a mechanical system consisting of a linkage made up of four gyroscopes suspended from one corner and weighted at the opposite corner. The self-excitation is said to be a resonance phenomenon determined by the apparent capacitance of the armature and the reactance of the external circuit.

The Schoop Process.—The Schoop process of squirting metal may be used, according to *E.T.Z.*, for forming the plates of condensers by depositing metal on glass. Also good electrical contacts may be produced by squirting metal on to the metal surfaces to be electrically connected. Carbon electrodes may be joined to metal terminals by the use of the squirting pistol. This has important application in the construction of electric furnaces for carbide and other substances, and in the manufacture of carbon brushes for dynamos. Brushes may also be made of metal deposited on paper, or another such support. The process is suitable for replacing soldering or brazing, for instance, in the construction of squirrel-cage armatures with aluminium bars, which are first coppered and then soldered. The joints of steel rails of electric railways may be connected by a deposit of zinc, thus eliminating copper bonds. Insulators may be coated with metal so as to improve in certain places the distribution of the electric field, and thus avoid local high intensities. It has even been proposed to make light accumulator plates by coating asbestos, fibre, or other light materials, with a layer of lead. Electric heaters are produced by squirting metal on to fireproof slabs.

Electrical Developments at Palmers' Works.—In referring to the reconstruction and modernisation of the iron and steel works at Palmers' Shipbuilding and Iron Works on Tyneside, Mr. Mure Ritchie, the chairman, stated, at a meeting of the company held at Newcastle-on-Tyne, that they were utilising waste gases from the blast furnaces for driving blowing engines and to drive the engines of the electric power plant which supplied the energy for the steel works, shipyard, and engine works. No more economical means of providing power to works had been discovered. Their 36-in. cogging mill had been electrified, and the electrical appliances in the roughing and finishing mills in the same train were now being installed. New electrical saws had been installed, and the cooling banks had been enlarged and modernised. Large new batteries of gas producers had been installed, with overhead railway tracks to supply the melting shops.

Institution and Lecture Notes.—Sheffield Society of Engineers and Metallurgists.—On April 7th, Mr. J. S. Atkinson read a paper before this Society on "The Application of Powdered Fuel."

Society of Technical Engineers.—The North-Western District Council of the above Society will hold a district mass meeting, at 7.15 p.m. on Friday, April 25th, 1919, at the Milton Hall, 244, Deansgate, Manchester, to which chemical, civil, colliery, electrical, mechanical, and mining engineers are invited.

South African Association of Municipal Electrical Engineers.—The third annual Convention of this Association was commenced at Port Elizabeth, on February 10th. Mr. B. Sankey, city electrical engineer of Port Elizabeth, was elected president for the ensuing year. The valedictory address of the retiring president (Mr. John Roberts, of Durban) was read, and an address was given by the new president.

Royal Institution.—The following are amongst the lecture arrangements at the Royal Institution, after Easter:—Prof. W. H. Bragg, two lectures on "Listening Under Water"; Dr. H. S. Hele-Shaw, two lectures on "Clutches"; Prof. Frederick Keeble, two lectures on "Intensive Cultivation"; Prof. H. S. Foxwell, two lectures on "Chapters in the Psychology of Industry: (1) Fourier and other Pioneers in the Movement for the Humanising of Industry; (2) Modern Industrial Organisation: Where it Fails to Observe the Humanities of Industry, and the Results." The Friday evening meetings, at 5.30 o'clock, will commence on May 2nd, when Prof. John W. Nicholson will deliver a discourse on "Energy Distribution in Spectra." Succeeding discourses will be given by Sir George Macartney, Dr. S. F. Harmer, Sir Alexander C. Mackenzie, Sir John Rose Bradford, and Prof. Sir Ernest Rutherford.

Sir J. J. Thomson, lecturing on Friday last, on the electrical properties of crystals, said that quartz crystals ran in twins, and whatever one twin did, the other twin was sure to do exactly the opposite. Tourmaline crystals were not entirely above suspicion, but they were more reliable. By a series of experiments it was shown how, by the application of pressure to the two ends of a tourmaline crystal, it was electrified positively at one end and negatively at the other end, the amount of electricity developed bearing direct relation to the pressure applied. By means of electricity generated in this way it was possible to draw curves enabling the exact time at which an explosion would take place to be calculated. One demonstration consisted in the application of red lead to one end of a tourmaline crystal and sulphur to the other end, with the result that the lead was electrified positively and gave forth a red light, and the sulphur was electrified negatively and gave forth a yellow light.

Hydro-Electric Power in India.—In the course of a paper on "The Industrial Development of India," read before the Manchester Section of the Society of Chemical Industry on April 4th, Mr. H. N. Morris said that the production of hydro-electric power would in the future have a very important bearing upon the development of India's industries. So far as he was able to judge, said the author, neither Switzerland, Norway, nor even Niagara, could compare with such schemes as the Koyna River and other water-power projects in India. Mr. G. Gunn, in the course of the discussion, said that in this country we were very much handicapped, simply because the Board of Trade would not allow power to be carried at a very high voltage.

Fatality.—An inquest was held at Chelmsford recently concerning the death of J. McAngus, 26, who, after demobilisation a few weeks ago, entered the employ of Messrs. Crompton & Co., Ltd., at the Arc Works, as a labourer. He was killed while at work through placing his foot on a bare connection of an electric cable. According to the evidence he was wiping down a machine with cotton waste, and put his foot on a 350-volt live cable, which had been placed under a table out of the way. Witnesses stated that the connection should have been covered with insulation, and it was an error of judgment on the part of a tester that it was not so covered. A file was found standing on end and making a connection between a cast-iron stool and one pole of the switch. But for the file anyone could have stood for any length of time where the deceased was, with impunity. Deceased was wearing boots with nails and iron plates on his heels. Artificial respiration was continued for some time. The Coroner said it was impossible to say how the file got there. The jury returned a verdict of "Accidental Death," and expressed the opinion that there was an error of judgment on the part of the tester in not having the cable properly insulated.

Wireless Interceptor.—With regard to German substitute materials, in a wireless interceptor manufactured by the Telefunken Co., the insulating materials used are remarkably inferior to any others that have yet been examined. There is an almost complete absence of ebonite, rubber, and brass, and the materials used in substitution would only have been employed under the pressure of great scarcity. The various switches, &c., are mounted in the usual manner on a slab screwed down to the box. This slab would normally be of ebonite; in the present instrument it is, however, made of three-ply white wood blacked over. The coupling coils are mounted, instead of on ebonite, on tubes of papier-mâché with white wood ends, and the windings are insulated with silk without any rubber. The terminal clips by which the dry cell is connected into circuit are mounted on what appears to be a poor quality of ebonite fixed to a wooden cylinder. The buzzer is mounted on a small disk of stoneware, and the connecting leads are insulated with paper. The variable condensers are not cut out of the solid aluminium, as in the best practice, but are composed of thin sheets of aluminium cast into corner blocks of babbit metal. All nuts and terminals are of gunmetal. The only ebonite that is used is in the knobs of the switches, and the thin graduated sheets mounted on the surface of the board indicating the positions of the various switches. The dry cell, instead of being sealed up with pitch, is closed at the top with four layers of cardboard.

Compensation Claim.—At Bolton County Court last week, compensation was sought from the Bolton Corporation for the death of John Clough, an assistant turbine engine driver at the electricity works, who died by drowning on January 25th. It was contended that he met his death in the course of his employment, but Mr. G. Jordan, for the respondents, cross-examined to suggest that it might be a case of suicide. Judge Spencer Hogg reserved judgment.

German Accumulators.—An accumulator, salved in May, 1918, seems to be of normal construction, and affords no evidence of shortage of materials. Its construction, however, is interesting as regards the method of allowing gases to escape, and returning spilt liquid into the cells. The battery consists of two cells in closed boxes of celluloid within an outer case of ebonite. The cells are separated by a small compartment with which communication is effected through both cells by glass tubes at the opposite ends of the cells, passing into the middle compartment, and dropping down to about three-quarters of the depth at the ends of the compartment, remote from the ends of the cells at which the glass tubes start. The middle compartment is provided with a vent so that gases can escape from both the cells through the central vent. Any liquid that accumulates in the middle compartment is returned to the cells by the siphon action of the glass tubes. The plates are held apart only by the action of combs of celluloid across the tops of the plates.

Big Conference of German Technicians at Eisenach.—For the first time delegates from all the engineering institutes, trades and schools in all parts of the Empire except the occupied districts met in conference in Eisenach on February 8th. Among those who attended were the Postmaster-General, the president of the Württemberg Technical Association, the presidents and delegates of the great mining technical organisations, and representatives of the German Engineers' Association, the Electrical Engineers' Society, various chemical associations, the Society of Architects, the Railway and Postal technical officials, &c. The conference is a result of the Revolution, which strengthened into action the long-entertained idea of a meeting of the entire German technical interests. The conference proceeded to settle its organisation, especially the statutes and lines of action of the association. It proposed that technical knowledge should have some part in all school programmes of study, and that in the high schools of other professions some instruction in technical affairs should be given; further, that the people should be made familiar with the working and importance of technical ideas for economy and culture, and technical experts of the necessary personal capability and knowledge should have more share than before in the work of public bodies with the powers of full members. The Association will also undertake to further the civil and citizen rights of its members and adherents. It has already achieved success in that among the members of Parliament elected since the Revolution, the number of technical engineers has increased tenfold. These have been in many cases consulted by the Foreign Office in the consideration of the peace conditions and their influence is on the increase. The limits of their competence were, however, clearly recognised by the conference, and the statement was applauded that great questions must not be regarded only from the technical standpoint. Great anxiety was evinced over the terms imposed by the Entente for the prolongation of the armistice, and the conference passed a resolution for transmission to the Government and National Assembly in Weimar, pointing out the great dangers of such concessions as the handing over of locomotives and agricultural machines, and asking that such pledges should not be made without previous consultation with the technical experts.—*Frankfurter Zeitung*, February 18th.

Accidents to Steam Turbo-Alternators.—A Sub-Committee of the "Union of Electrical Syndicates" has reported on the means for restricting accidents to turbo-alternators, says the *Revue Générale de l'Electricité*.

According to the evidence collected it appears that the machines that heat most are subject to the most frequent breakdowns, even if they are for moderate voltages and are protected from short circuits by external choking coils. It is, therefore, important that more attention should be paid to the question of overheating than hitherto. Machines for more than 10,000 volts seem to be too sensitive, and if higher transmission voltages are necessary, it is desirable to consider the use of autotransformers to double the generator voltage. An advantage of using transformers lies in the absence of the need for external choking coils. For very large alternators the voltage should be limited by the employment of a reasonable number of slots and two conductors per slot.

The usual statement that short-circuit currents are limited by added reactance is a fallacy. The added reactance must be in the leakage circuits of the stator and rotor, and external reactance does not reduce the instantaneous short-circuit current. Designers should therefore take steps to increase the leakage reactance of the machine and dispense with external current-limiting reactance.

The insulation of turbo-alternators should be of a higher grade than that of the general run of machines, and the interstices should be filled with impregnating material that remains solid at 100 deg. C. The insulation tests should be taken at 2.5 times the normal voltage for generators destined for use in generating stations where the liability to accidents is normal, and at three times the normal voltage, if there is reason to suppose that the machine will be subject to abnormal stresses owing to the nature of the line to be served. The insulation between various sections of the winding should be tested during construction at the normal voltage of the machine.

Temperature indicators (thermo-electric or resistance) should be built into the windings at positions that are enumerated.

The committee is of opinion that the suggestion to subject finished sets to sudden short-circuits offers more disadvantages than advantages. The limitation of the consequences of a breakdown should be effected by devices for shutting off air circulation and injecting steam or some non-combustible gas. It is useful to provide excess voltage relays for automatically opening the field circuit, rather than the armature circuit, when a short circuit occurs.

New Zealand Water-Power.—The hydro-electric scheme for the North Island was submitted to the New Zealand Parliament on November 29th. The scheme was prepared by the late chief electrical engineer, Mr. Evan Parry, and provides for three large generating stations to distribute energy to the whole of the North Island. The sources of power to be used are the rivers Mangahao, Waikaremoana, and Arapuni. It is proposed to supply energy to every householder on the island, every industry requiring power, and also for main-line railway electrification. For this purpose a supply of 160,000 H.P. would be required, to be generated as follows: Arapuni, 96,000 H.P.; Waikaremoana, 40,000 H.P.; and Mangahao, 24,000 H.P. This would be equivalent to one-fifth horse-power per head of population. The length of transmission lines would be 1,421 miles, with 29 sub-stations, and the scheme would be capable of further development later. The total capital expenditure is estimated at £7,599,441, including interest during construction and financial assistance to local authorities. Capital charges are put at £547,728 per annum, and working expenses at £200,000.

A similar scheme for the South Island has not been worked out, but would consist of a system of power stations linked together, and would cost less than the North Island scheme.

The question of railway electrification, says Mr. Parry, is already urgent, and in course of time an electric service on both road and railway will be a necessity; there is no question as to the advantages of electricity where frequent service is required. Another branch of electric haulage which may have an important effect on the future of New Zealand is the provision of light railways for agricultural purposes.

Referring to the distribution of power, the report says that it would be possible to supply the whole of the North Island from one central generating station, but this would not be the best method. Energy can be transmitted at 100,000 volts up to 150 miles without serious difficulties, but greater distances give rise to trouble. It is laid down that, as a general rule, it would pay to develop any sources of power yielding 20,000 H.P. or over on a 50 per cent. load factor, at a cost of £20 per H.P. or under, as an alternative to transmitting energy 130 miles from another source.

The scheme does not provide for large special metallurgical processes, but is confined to the ordinary lighting, heating, and industrial load, with limited amounts for railway electrification, electrochemical and electrometallurgical industries.

The development of the Waikato district would entail heavy expenditure in the initial stages, and would take some time to carry out; this could be obviated by the acquisition of the plant of the Waihi Co., at Hora Hora, which is at present only working at half its capacity.

The power from the Mangahao River would be obtained by diverting the water by means of tunnels and pipes of a total length of about three miles, and there would be a fall of about 900 ft. at the power station. The complete installation is estimated to cost £438,654, or £18.3 per H.P. delivered on the main transmission lines.

In connection with the development of Lake Waikaremoana, it is proposed, as a first stage, to divert the River Waikaretaheke into Lake Kaitawa, and thereby obtain 29,000 H.P. This scheme could be extended to produce 156,000 H.P., but is a long distance from any load, and it is only proposed to develop 40,000 H.P. The cost is put at £544,369, or £13.16 per H.P.

For the Auckland and main trunk supply, and the bulk of the Taranaki supply, alternative schemes have been selected at the Arapuni Gorge and the Waikato River, of which the Arapuni is the better, provided the construction of the big dam is practicable. This scheme would produce 162,000 H.P., but only 96,000 would be required for the present purpose. The cost of the power station is put at £1,078,700, or £10.78 per H.P., and if the scheme were extended to produce 162,000 H.P. the cost would be £1,426,707, or £8.78 per H.P.

Another scheme is for the development of the Ariatia Rapids, but this does not fit in with the general scheme; by the construction of a dam a fall of 175 ft. could be obtained, which would produce 135,000 H.P.

The transmission lines provided for are of the suspension type, on ironbark poles, with steel towers in special places. A considerable part of the total length of 1,421 miles would go across country, and would be of a substantial type; the cost is estimated at £1,795,240. The main sub-stations would transform energy down to 11,000 volts for transmission to smaller sub-stations, which would supply the local authorities and power users. The cost of the main sub-stations would be £838,808, and of the secondary sub-stations and distribution lines, £2,086,000. All the estimates are prepared on the basis of a 12 per cent. increase on pre-war prices.

It is proposed to provide a fund to assist local authorities in increasing the load by advancing money on loan, and to assist manufacturers in the installation of electrical plant.

The estimated total capital expenditure per H.P. is £45.63, which compares with £50 per H.P. for the Lake Coleridge scheme, the success of which is already assured.

The Minister of Finance said that a Bill would be presented providing for the whole scheme, but at present no labour was available.

Exhibition of Electromedical Apparatus.—The exhibition organised by the British Medical Association, and held at the Imperial College of Science and Technology, South Kensington, was closed on Friday after a successful run of three days. There was much of interest both to be seen and heard, though chiefly from the medical rather than the electrical point of view. A number of interesting papers were read and demonstrations given at the various London hospitals in connection with the exhibition in the sections of surgery, medicine, preventive medicine, and pathology. A demonstration of X-ray apparatus was given on Friday afternoon at the War Office X-ray Laboratory, Fulham, and amongst the exhibitors of electromedical apparatus, embodying the latest advances in X-ray technique, were Messrs. Harry Cox and Co., Ltd., and the Medical Supply Association.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials. — The Sunderland T.C. has advanced the salary of the electrical engineer (MR. A. S. BLACKMAN), from £1,000 to £1,200.

MR. A. W. ANNETS, borough electrical engineer at Morecambe, has resigned.

The Carlisle T.C. has increased the salary of MR. H. P. BAYNHAM, chief assistant engineer at the electricity works, to £225 a year, plus 35 per cent. war bonus, as from February 11th last.

The Malvern U.D.C. has increased the salary of the gas and electrical engineer (MR. TROW SMITH) to £475 per year.

The Reading T.C. has increased the salary of MR. F. H. GLOVER, works assistant engineer of the tramway department, from £180 to £192 a year; and that of MR. R. J. FARDELL, chief clerk, from £180 to £200.

The Gillingham (Kent) T.C. has increased the salary of the chief assistant engineer at the electricity works (MR. D. W. RITSON), to £200 a year, exclusive of war bonus.

The Bradford City Council has approved the increase of the salary of the City electrical engineer (MR. THOS. ROLES), by £250 per year to £1,250, and also the advance to the deputy electrical engineer.

The Accrington Corporation Electricity Committee has recommended that the salary of the borough electrical engineer (MR. A. W. CLEGG) be increased by £100. His present salary is £500, and the increase is conditional that he remains with the Corporation for at least two years.

General. — MAJOR GERALD HOOGHWINKEL, R.F.A., M.I.E.E., M.I.M.M., of Messrs. Hooghwinkel, Anthony Brown and Partners, consulting engineers, has recently arrived home from France on demobilisation. Major Hooghwinkel joined the R.F.A. in 1914, and, after training, went to Gallipoli in 1915. He subsequently saw active service in Egypt, Salonika and France, remaining there until recently. He is taking up his consulting practice again after 4½ years' absence. CAPT. ANTHONY BROWN is still on General Allenby's staff in Egypt, but hopes to return soon. He went with his regiment to India in 1914, and acted as A.D.C. to the Viceroy for three years. The firm has recently opened a branch office in Paris, and is interested in reconstruction schemes in France and Belgium.

SIR ADAM NIMMO, K.B.E., has resigned his position in the Coal Controller's Department.

MR. J. L. H. COOPER, B.A., has resigned his position as assistant resident electrical engineer of the Great Central Railway Co., at Immingham and Grimsby Docks, and has commenced practice as a consulting electrical engineer at Grimsby and district. His business address will be Royal Dock Chambers, Grimsby.

MR. A. BLACK, power superintendent, Messrs. J. & P. Coats, Ltd., Paisley, has been appointed chief engineer at Manor Mills, of the Dunlop Rubber Co., Ltd., Birmingham. He takes up his new duties early in May, and will be glad to receive latest catalogues and lists from manufacturers of steam, hydraulic and electrical plant and equipment, and all accessories connected therewith.

A complimentary dinner and presentation to MR. D. G. SUMNER, of Messrs. L. E. Wilson, electrical engineers, Manchester, took place on Thursday, April 10th, at the Midland Hotel, Manchester, to celebrate his safe return from Persia, for the second time, and also to mark the successful completion of the important electrical work undertaken in that country. A number of guests from the East were present.

Roll of Honour.—The Military Medal for conspicuous bravery in Mesopotamia, has been awarded to LANCE-CORPORAL W. SIDDLE, who was, prior to the war, on the Corporation electricity staff at Warrington.

Obituary.—MR. A. J. WALTER, K.C.—We regret to learn that Mr. Arthur James Walter, K.C., was killed on the London Underground Railway on Wednesday last week. The *Times* very correctly observes that both the Bar and Science have suffered a great bereavement by his death, for he was pre-eminent among barristers learned in patent law and scientific matters, and for many years was in demand for cases in which these two specialised and highly technical subjects were involved. He had a private laboratory in which he indulged his scientific tastes in connection with electricity and chemistry. He will be remembered by our readers from his appearances in well-known electrical patent litigation, including the Marconi patent cases. Mr. Walter was an associate of the Institution of Electrical Engineers, since 1899, and had served as a member of the Council. When his death became known in the High Court, both Bench and fellow counsel alluded in terms of high praise to his exceptional qualifications and attainments and spoke of the great loss sustained by the death of so brilliant a man.

The death is announced from Bodenbach, Austria, of HERR CARL BORCHARDT, director of the Oesterreichische Bergmann Electricitätswerke.

SIR WILLIAM CROOKES.—The Institution of Electrical Engineers was represented at the funeral service for the late Sir William Crookes, O.M., F.R.S., past president, by Mr. C. H. Wordingham, C.B.E., president; Colonel R. E. Crompton, C.B., Mr. W. M. Mordey, and Prof. J. Perry, F.R.S., past presidents; Mr. J. Devonshire, Sir R. Hadfield, Bart., F.R.S., Mr. W. Judd, and Mr. A. P. Trotter, members of Council; Mr. R. D. Grieves (representing Sir John Snell), past president; and Mr. R. Tree representing Mr. Rowell, the secretary.

Wills.—SIR GUY CALTHROP, the late coal controller, left £15,300.

The late MR. WM. CORDREY, governing director of W. H. Willcox and Co., Ltd., left £137,354.

CITY NOTES.

New York Traction Difficulties. The following interesting comments are reproduced from the *Times* financial column: "There have occurred two new receiverships among the traction companies of New York City—both foreseen, and to some extent discounted. The New York Railways Co., which is the subsidiary of the Interborough Consolidated Corporation, controlling most of the surface roads on Manhattan Island, gave up the fight against an increasing deficit on March 19th; the parent company followed it into a receiver's hands two days later. So far the money-maker of the combination, the Interborough Rapid Transit Co., has kept out of the courts; but it, too, is having a struggle to keep its head above water. When it passed its March dividend it brought into question the payment of interest on the Interborough-Metropolitan 4½ per cent. bonds, falling due on April 1st. These bonds were exchanged, originally, for Interborough Rapid Transit stock, on the basis of $200 in bonds for $100 in stock, and as the Rapid Transit Co.'s annual dividend was 9 per cent., the receipts from this source exactly met the bond interest. Officers of the Interborough Consolidated Corporation were frank to say, even before that company went into a receiver's hands, that the Interborough-Metropolitan April interest could probably not be paid, and a protective committee for the bondholders has been formed with the Guaranty Trust Co. as depositary. The Interborough Rapid Transit Co., it should be said, controls the ordinarily very profitable subway and elevated road systems of Manhattan, and a part of the systems in Brooklyn. Its only rival in Brooklyn is the Brooklyn Rapid Transit Co., which went into receiver's hands some time ago. The troubles of all New York City's traction companies are the same. In the numerous consolidations to which they have been subject their capitalisations have been swollen out of proportion to their real worth, and the inherent weakness of their financial structure has been brought out by the present era of high costs of labour and materials. Through war-time delay in completing new subways, in which large amounts of money have been sunk, the contracts with the city government have been thus far profitless. There is owing to the Interborough organisation alone, on account of its preferential right to earnings from subways, more than $6,000,000. The city government has consistently blocked every effort on the part of the traction companies to increase their rates of fare, for reasons that are almost entirely political, having mostly to do with municipal ownership programmes."

Companies to be Struck Off the Register.—The following are to be struck off the Register within three months unless cause is shown to the contrary:—

Acousticons, Ltd.
Defries, Ltd.
Derby Boiler Co., Ltd.
Electrical Industries Development Co., Ltd.
Electric Hiring Syndicate, Ltd.
Electro-Chlorination Syndicate, Ltd.
Tube Cleaners, Ltd.

London Electric Railway Co.—The "Financier" states that the directors have decided to petition Parliament for leave to introduce a late Bill, mainly for the purpose of raising money to construct the works authorised in 1913 and 1914, in addition to the capital then authorised for those works. The money required will be raised by the issue of £1,000,000 new debenture stock.

Prospectuses.—*Major & Co., Ltd.*, who have been carrying on business as chemical manufacturers at Hull, and have produced various products including fuel oil, wood preservatives and electrode carbon, have been offering for subscription at par 100,000 7 per cent. cumulative participating preferred ordinary shares of £1 each. The money is required to provide additional working capital for the extending business, and redeeming the 5½ per cent. debentures.

Fuller's United Electric Works, Ltd.—The list is to close on April 23rd in an offer for sale of 200,000 8 per cent. cum. participating preference shares of £1 each at 21s. per share. Reference is made to the matter in our "Stocks and Shares" Letter to-day.

Western Power Co. of Canada.—Report for 1918 states that operating revenues amounted to $448,709, against $450,160, and operating expenses to $163,418, against $130,559, net operating revenues being $285,291, against $319,601, and gross income $294,078, against $331,793.—*Financial Times.*

Rhondda Tramways Co., Ltd.—Preference dividend 6 per cent. (being 4 per cent. for 1913 and 2 per cent. on account of 1914); £10,000 to renewals and reserve; £1,044 carried forward. The gross revenue for 1918 was £98,862, against £82,255 for 1917. The passengers carried were 13,926,707, against 12,865,806 for 1917. The average receipts per c.m. were 16.73d., against 13.87d.; receipts per passenger 1.67d., against 1.50d.

Lancashire Dynamo & Motor Co., Ltd.—A further dividend of 5 per cent. has been declared, making 10 per cent., free of tax, for 1918. The *Financial Times* states that for each of the three preceding years 12½ per cent. was paid on the capital as it then stood, 47,551 ordinary shares having been issued in April, 1918.

Stock Exchange Notice.—Application has been made to the Committee to allow the following to be quoted in the Official List:—

British Westinghouse Electric & Manufacturing Co., Ltd.—185,000 additional 8 per cent. cumulative preference shares of £2 each, fully paid (Nos. 500,001 to 685,000).

Consolidated Electrical Co., Ltd.—Income for year ended March 31st £5,846; net, £3,750, plus £2,947 brought forward. Dividend on ordinary shares, 2½ per cent.

Vickers, Ltd.—The 1918 accounts are not yet completed, but a final dividend is recommended on the old ordinary shares of 1s. 6d. per share, equal to 7½ per cent., free of tax, making a total of 2s. 6d. or 12½ per cent. The holders of the new ordinary shares are entitled to a final dividend at one-half the above rate, namely, 9d. per share, or 3¾ per cent., free of tax.

London United Tramways, Ltd.—Last week the Chancery Court sanctioned the scheme of arrangement and reduction of capital which had been adopted by the different classes of holders. There was no opposition.

Anglo-American Telegraph Co., Ltd.—Interim dividend for quarter 15s. per cent. on ordinary and £1 10s. per cent. on preferred, less tax.

Electrical Utilities Corporation, Ltd.—Quarterly dividend of 1¼ per cent. on preference shares.

STOCKS AND SHARES.

Saturday Morning.

Near advent of the Easter holidays has made little difference to Stock Exchange markets. The booming conditions in oil shares have stimulated animation elsewhere. Industrials enjoy high popularity. Labour bogeys have been pushed unceremoniously into the background. Investors are taking new issues with marked freedom. Quick premiums are established upon sound shares. Midland Power Distribution preference are 5/32 premium in Liverpool and, if anything, rather better in London. Intangible rumours hint at a few of the electricity supply companies coming into the market for fresh funds. We, of this column, cannot trace any foundation for such reports, but they are not inherently improbable, and when capital is manifestly complacent to lend, there is seldom a dearth of borrowers.

East London Railway ordinary stock has suddenly come to life, and a fair amount of business developed in the stock about 4¾ to 4¼. The debenture stocks have not moved, the third and fourth being quoted 18½ and 12 respectively. City and South-London ordinary was last dealt in at 12, on February 2nd, 1918! For that year the company paid 1¾ per cent. on its ordinary stock, comparing with 1¼ per cent. on Metropolitan Railway Consolidated, which stands at 26½, while Districts, now 23¾, have received nothing for 37 years. When the new capital is provided for reorganising the rolling stock, &c., of the City & South-London, the company should have at least a chance of greater success. There is no lack of traffic, as passengers know to their sorrow.

Underground Electric income bonds have risen to 96. With the Budget coming on April 30th, the demand for tax-free dividend stocks is quickened, and this explains further small improvements in the Eastern Telegraph group. Attention may be drawn to Telegraph Constructions, which at 24 yield 5 per cent. net on the money, equal to 7½ per cent., allowing for tax at 6s. in the £. Recently divided by two, on the doubling of the share capital, the possibilities are in favour of an increase in the dividend, and the security offered by the shares as a sound investment is undoubted.

After rising to a shade above £5, Marconis gave way as earlier buyers elected to take their profits. The price slipped back to 4 13/16, but fresh support came in, and the market regained buoyancy. Marconi Marines have also rallied, and a further improvement is anticipated by the speculative brigade upon the shares being quoted ex the rights offered by the new issue. Canadian and American Marconis are both rather heavy: the former suffer from having been overbought on a Stock Exchange tip circulated when the price stood about 16s. It is now 15s. 9d.

Indian Tramway shares are in request, and Calcuttas have hardened to 7¼. The 5 per cent. preference are 4, and the 4½ per cent. debenture stock is 71, as against 99½ upon the outbreak of war. Madras Electric Tramways 6 per cent. preference have firmed up to 4½, and the company's 5 per cent. debenture stock is 86. Rangoon 6 per cent. preference are also about 4½. The Brazilian Tramway bonds show a dullish tendency. Rio firsts and seconds are both ½ lower at 94½ and 81 respectively. Mexican Utilities have hardly moved. British Columbia Electric issues remain flat. Canadian Tramway descriptions were unaffected by threats of strikes.

The manufacturing group keeps very steady, but there is no outstanding feature of interest. Underwriters say they are being offered plenty of stock for after-Easter. A rally amongst rubber shares deserves notice, but the price of the produce is still just under a florin per lb. Golfers wonder why the price of golf balls is maintained at the level to which it was advanced when rubber rose to 10s., and over, per lb. Rubber has dropped to 1s. 11½d., but golf balls are dear as ever. The iron, steel, and armament lists are better, for choice, on the settling-down of Labour conditions in the industrial areas.

The prospectus is now published of Fuller's United Electric Works, Ltd., and 200,000 8 per cent. cumulative participating preference shares of £1 each are offered for sale at a guinea apiece by Messrs. George Clare & Co., Ltd., of 9, Old Broad Street, E.C. The company has acquired four companies in the electrical business, making, amongst other things, accumulators, primary batteries, electric wire and cable, and miners' electric lamps. Details of the company's assets, together with a profit statement for each of the past three years, are furnished in the prospectus.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price April 8, 1919.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	8	7½	—	£6 8 0
Charing Cross Ordinary	4	4	5⅝	—	5 14 4
do. do. do. 4½ Pref.	4½	4½	6⅝	—	6 13 4
Chelsea	8	8	8	—	4 1 1
City of London	8	8	11¼	—	6 14 8
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10⅝	—	6 11 0
do. do. 6 per cent. Pref.	6	6	9⅞	—	6 1 1
Kensington Ordinary	7	6	6¼	—	5 2 2
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	6	6	7¾	—	7 14 10
Metropolitan	4	5	5½	—	7 18 10
do. 4½ per cent. Pref.	4½	4½	5½	—	6 18 6
St. James' and Pall Mall	9	10	7½	—	7 0 4
South London	6	6	7½	—	6 19 4
South Metropolitan Pref.	7	7	30/6	—	6 16 7
Westminster Ordinary	9	8	6½	—	6 0
Telegraphs and Telephones.					
Anglo-Am. T l. Pref.	6	6	09½	—	8 0 7
do. Def.	1½	83/8	21½	—	7 18 0
Chile Telephone	8	8	7½	—	5 8 6
Cuba Sub. Ord.	7	7	11	—	*8 7 4
Eastern Extension	8	8	16	—	*5 0 0
Eastern Tel. Ord.	8	8	161½	—	*4 19 0
Globe Tel. and T. Ord.	7	7	14½	—	*4 16 7
do. do. Pref.	6	6	10⅜	—	5 14 8
Great Northern Tel.	22	23	81	—	7 2 0
Indo-European	13	13	87½	—	5 13 0
Marconi	20	20	5	—	4 0 0
Oriental Telephone Ord.	10	15	2⅞	—	6 3 0
United R. Plate Tel.	8	8	7¼	—	*5 1 7
West India and Panama	1/8	1/8	1⅛	—	*0 17 0
Western Telegraph	8	8	16½	—	*4 15 10
Home Rails.					
Central London Ord. Assented	4	4	62½	—	6 8 0
Metropolitan	1	1½	26½	—	4 14 7
do. District	Nil	Nil	23¾	—	Nil
Underground Electric Ordinary	Nil	Nil	8¾	—	Nil
do. do. "A"	Nil	Nil	9/8	—	Nil
do. do. Income	4	5	94½	—	*5 5 10
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4⅜	—	6 11 4
Anglo-Arg. Trams. First Pref.	5¼	Nil	8½	—	—
do. do. 2nd Pref.	—	—	3½	—	—
do. do. 5 Deb.	5	5	67⅛	—	7 8 5
Brazil Tractions	—	—	54	—	—
Bombay Electric Pref.	6	6	102	—	5 11 7
British Columbia Elec. Rly. Pfce.	5	5	62	—	8 0 0
do. do. Preferred	Nil	Nil	40	—	Nil
do. do. Deferred	Nil	Nil	41	—	Nil
do. do. Deb.	4½	4½	61	—	6 19 4
Mexico Trams 5 per cent. Bonds	Nil	Nil	61	—	Nil
do. 6 per cent. Bonds	Nil	Nil	62	—	Nil
Mexican Light Common	Nil	Nil	37	—	Nil
do. Pref.	Nil	Nil	51	—	Nil
do. 1st Bonds	Nil	Nil	68	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	87	—	4 0 0
British Aluminium Ord.	10	10	1[illegible]	—	5 16 8
British Insulated Ord.	25	12½	2	—	6 5 0
British Westinghouse Pref.	7½	7½	2⅜	—	6 3 0
Callenders	25	25	10	—	6 5 0
do. 6½ Pref.	5	5⅛	5½	—	5 8 10
Castner-Kellner	25	20	8½	—	6 2 1
Edison-Swan, "A"	—	—	1⅞	—	7 5 8
do. do. 5 per cent. Deb.	4	5	75½	—	6 12 3
Electric Construction	10	10	1½	—	6 0 0
Gen. Elec. Pref.	6	6½	10⅜	—	6 5 4
do. Ord.	10	10	17½	—	*5 12 0
Henley	25	25	2½	—	5 8 2
do. 4½ Pref.	4½	4½	4	—	5 12 8
India-Rubber	10	10	16½	—	*6 19 3
Siemens Ord.	—	10	6⅝	—	*7 11 0
Telegraph Con.	20	20	24	—	5 0 0

Dividends paid free of Income Tax

"RULES" IMPOSED BY ELECTRIC SUPPLY AUTHORITIES.

By CHARLES A. BAKER, M.I.E.E.

The "rules" to which attention is directed in this article are those imposed by the electric supply authorities upon the consumers, under the various titles of regulations, terms, conditions, &c., and any criticism, comment, or suggestion is directed to such "rules." The supply of electricity is largely governed by regulations and conditions made by the Board of Trade, under section 6 of the Electric Lighting Act, 1882, for securing the safety of the public, and for ensuring a proper and sufficient supply of electrical energy; it is not the intention of the author to discuss these regulations, but they are referred to from time to time, and in such cases are read as parts of the Act to which they refer.

The subject is the common ground where the vendor of electrical energy meets the purchaser or consumer, whilst wiring contractors and manufacturers of all descriptions of electrical appliances are interested because every new consumer attached to the mains means new business. Many of the electric supply managers and engineers get a perspective view of the subject which is taken at too close a range, they generally demand that "rules" laid down by themselves be accepted; it must not be forgotten, however, that the Acts authorising the supply of electricity establish in a measure the grant of a monopoly or an "area" for the conduct of business wherein opposition is strictly limited, and clearly defined obligations are imposed in order that the public may benefit by the undertaking. The consumers have very substantial rights, which they are under no compulsion to sign away in order to obtain a supply of electrical energy.

It can, I believe, be shown that the deletion of some "rules" will benefit the industry and remove difficulties, encouraging rather than discouraging consumers to be connected up to the supply mains; if existing "rules" assisted in economy, low price, or security of supply, no word should be raised against them, nor should any substitute for them be permitted which might derogate from economical working.

It should not be assumed as a result of perusing this article that the electric supply authorities are all generally taking advantage of their consumers; the "rules" which are quoted are from different sources, and it is not suggested that any supply authority's form of agreement embodies all the bad points herein noticed, whilst some of the agreements may not embody any of them; uniformity and simplicity are, however, as desirable in this as in many other matters.

Whilst taking part in the discussion of Mr. Seabrook's Institution paper on "Residence Tariffs" in 1912, the author referred to the subject of "rules" in very plain though condensed language (*vide* I.E.E. *Journal*, Vol. 48, p. 419); several members of the Institution also mentioned the subject during Mr. Ferranti's presidency, whilst taking part in the discussion on "The Causes Preventing the more General Use of Electricity for Domestic Purposes." There can be no doubt that a cumbersome application form involving a lengthy agreement is a stumbling block; the incautious consumers are prone to take for granted that what they are asked to sign is exactly what everybody else has signed, which, as a matter of course, has been carefully examined by the police or some other central control body which watches over their general security, so it is sure to be all right, and therefore they need not trouble to read it; whilst the cautious consumer is annoyed and frightened, annoyed at being obliged to waste the time necessary to read through and grasp the relative bearing of a lot of clauses, and frightened at the way he finds that he is asked to put himself into the hands of the other part to the agreement. There remains the class of consumer who is big enough, and bold enough, to look after himself; he strikes out all or most of the clauses, or employs his solicitor to draft a simple notice requiring the supply authority to give a supply by a definite date in accordance with the terms of its Provisional Order, and he gets the supply which he is entitled to.

The Incorporated Municipal Electrical Association drafted and revised in 1914 "Model General Conditions for Supply of Electrical Energy," consisting of 16 clauses with blank spaces for filling in "local regulations" and "local clauses." Up to the point when a Provisional Order is granted to some person or company it is safe to assume that the interests of the public, whom the Provisional Order is intended to benefit, have been carefully watched and guarded by a competent tribunal and its officials; to *vary* the terms of such Provisional Order by a subsidiary agreement is a proceeding that should generally be avoided by the public because it is dangerous.

It may be stated generally that although some electric lighting Provisional Orders contain special clauses, yet all granted in and since 1889 are in the same model form; this model in 1899 assumed concrete form as the Electric Lighting (Clauses) Act.

The Provisional Orders clearly set out that the supply authority is bound to lay mains on being required to do so and to supply energy; any person requiring a supply must serve a notice upon the undertakers, specifying the premises in respect of which the supply is required, and the maximum power required . . . and if required by the undertakers, enter into a written contract to continue to receive and pay for a supply for a period of at least two years . . . and give security for the payment; if the occupier uses any form of lamp, &c., in a manner so as to interfere with the efficient supply to any other person, the undertakers may discontinue to supply energy to those premises; the undertakers shall not be compelled to give a supply unless they are reasonably satisfied that the electric lines, &c., are in proper order. On the other hand, the supply authority must not prescribe any special form of lamp or burner, and every person is entitled to a supply on the same terms on which any other person is entitled under similar circumstances to a corresponding supply, and the supply authority must not show any undue preference.

Here, then, is the basis for a written contract—and, as far as I can find, the only basis—which is intended to give the supply authorities reasonable financial security for the cost of the work done in connecting the consumer, and for the value of the energy supplied, and the right to verify that a consumer's installation is in reasonably good order to prevent any abuse of the service which might be detrimental to other users, whilst the supply authority must not exercise any voice in the form of consuming device employed, and must treat all consumers alike.

In practice what happens, as is well known, is that, when an individual or firm desires to become a consumer, an "application form" is sent to him by the supply authority; such application forms generally vary for each particular supply authority—there is a noticeable absence of uniformity amongst them—but they are usually drafted on such lines that by signing the application form an agreement is entered into containing clauses which

do not come within the basis of the written contract already adumbrated.

My experience of these documents is principally in connection with those of the supply authorities of London and the neighbourhood, but I have had the opportunity of perusing a considerable number of similar documents issued from provincial centres, and from the consumer's point of view there are usually clauses squeezed in which in justice ought not to be there, or, if there at all, should be modified in tone. I do not find that any of these "rules" purport to be imposed under any specific clause of the respective Supply Authority's Acts, nor is there any indication that they have been approved by the Board of Trade. In other matters the author has found that the Board of Trade, before approving rules, requests that due notice of the intention to make rules shall be advertised, and any parties desiring to raise objection are given a hearing, but no such reasonable and fair opportunity has ever been given to the consumer of electrical energy in regard to the "rules" imposed by the majority of the supply authorities. If some of the "rules" were put forward as suggestions, a principle which has been adopted in a few cases, they might be found deserving of considerable merit whereby the consumer would benefit if he so desired, but a suggestion and a rule are very different things. The authority which imposes a rule without the right to enforce it places itself in a most unenviable position; this position has perhaps been created in some instances by the interference of the secretary or town clerk or other official concerned in the undertaking with the duties of the manager or engineer of the electric supply authority, or one or more of the directors or town councillors may have suggested that a water or gas or other commercial undertaking with which he was associated found a certain rule useful, and therefore applied it to the electrical undertaking without regard to the fact that the latter is a statutory undertaking, with important duties to the public, and with strictly limited powers in the direction of imposing rules.

Whilst dismissing any claim to legal knowledge, one must unfortunately approach this subject from the dry and uninteresting standpoint of the law, and on referring to the very excellent and comprehensive work by the late John Shiress Will "The Law Relating to Electric Lighting, Power, and Traction," I fail to find that the supply authorities have any power under the Electric Lighting Acts to impose rules upon the consumers who take a supply of electrical energy for domestic, manufacturing, or other purposes. (In the case of a supply at *medium pressure* the supply authority should see that Board of Trade requirements on the consumer's premises are carried out, but such a case is special, and need not be considered here.)

In the majority of the "rules," one or more clauses are to be found expressing conditions as to how the wiring of the premises is to be effected; it has been already pointed out that the supply authority cannot be compelled to give a supply unless satisfied that the electric lines, &c., are in proper order. This is amplified in regulation No. 29 of the Board of Trade, "for securing the safety of the public," which is as follows: "The undertakers shall not connect a consumer's wires with their mains unless they are reasonably satisfied that the connection would not cause leakage . . . exceeding one ten-thousandth part of the maximum supply current to the premises; and where the undertakers decline to make such connection they shall serve upon the consumer a notice stating their reasons for so declining." As an example of how this is interpreted by one of the supply authorities I quote the following rule: "No installation will be connected to the distributing mains until it has been (1) tested and inspected, and (2) the supply authority's conditions of supply and the wiring regulations they enforce have been complied with. (3) At the time arranged for the test and inspection there must be in attendance to meet the supply authority's representative a representative of the wiring contractor capable of giving any information required respecting the installation. . . . (4) The wiring contractor must also provide any ladders or steps which may be necessary to make an examination of the work; (5) and if required, must remove all lamps from their holders for the purpose of a further test for insulation resistance between poles. The supply authority will test and inspect each new installation once, free of charge, but (6) if the wiring . . . be found to be defective or unfinished, or not to conform to the requirements, the defects, &c., must be remedied, and another inspection must be made. (7) All test orders after the first must be accompanied by a fee of 5s., in default of which they will not be acted upon. Electricity will not be supplied if (8) the installation does not comply with these conditions and the wiring rules of the Institution of Electrical Engineers, both as regards the manner in which the work has been carried out and the insulation resistance obtained on test." Such a "rule" forms an excellent example of an apparent underlying desire on the part of the supply authority to withhold giving a supply, to discourage any consumer wanting a supply; although the supply authority is established with a view to providing for a public necessity, it fences itself round with obstacles that may keep consumers off its mains.

The "rule" indicates (1) that the supply authority claims a right to go all over the premises of the consumer to inspect the installation, whatever the nature of the premises may be—a castle or a workshop; this is emphasised in a "rule" quoted later, and is a condition certainly never intended to be created by the Electric Lighting Acts, nor is it possible to justify any such procedure upon any ground of usefulness on the part of the supply authority. The right to test is admitted, but not the right of inspection as suggested in the "rule." The next point (2) raised by the "rule" concerns the supply authorities' conditions of supply and wiring regulations; under *neither* heading has the supply authority any right to make conditions or regulations. The "rule" proceeds (3) to compel the wiring contractor—a gentleman not referred to in the controlling Acts or Board of Trade Regulations—to attend and afford any information, and (4) to provide ladders, &c., and unless all this is done the installation will not be connected. (5) "If required all the lamps must be removed for a test between poles." The Board of Trade regulation, quoted above, refers only to leakage to earth which might interfere with the supply to other premises; no test between poles is, in the author's opinion, contemplated by the regulation. It is interesting to note that the new edition (1916) of the Institution of Electrical Engineers' Wiring Rules differs from the original rule on this point. Rule 129 (1916) introduces a test between poles which was not provided for in Rule 121 of the 1911 edition. Then (7) as to levying a fee—which is usually stated to be 5s.—for making a second test, I cannot find that any supply authority has the right to charge such a fee, and believe that such an imposition—if it ever is imposed—is illegal. The position is this: A consumer decides upon his installation, and in due course notifies the supply authority that he requires it to give him a supply at certain premises by a certain date of a certain maximum demand; on testing the installation the supply authority finds, let us suppose, a weak spot, and declines to connect; the weak spot must evidently be put right, and a new notice served upon the supply authority in exactly similar terms to the last one, with the exception of an altered date. The supply authority can come again and test if it pleases; but, unless

there is good reason for continuing to decline to connect the consumer, it renders itself liable to a penalty under its Provisional Order if it fails to make the connection, and the non-payment of a fee —unauthorised by the Provisional Order—could never be accepted as a good reason for declining to connect an installation; the supply authorities are entitled to charge for energy supplied and for the supply or hire of meters, and in some cases for laying services, and for nothing else. One other point in the "rule" which invites attention is that requiring the wiring to be done according to the Institution of Electrical Engineers' Rules and insulation resistance figures. The Institution's Wiring Rules have everywhere received unstinted praise, and so far as the author is aware, no adverse criticism of them has been attempted—presumably, therefore, it is not possible—and if these excellent rules were *suggested*, by the supply authorities, a good service would be done to their consumers; but the supply authorities must not enforce these rules, they have absolutely no power to do so. It will at once be seen that the insulation resistance figures under the Institution of Electrical Engineers' Rules are not the same as those necessary under the Board of Trade regulation. Take, for example, an installation of 50 20-watt lamps; by the Institution of Electrical Engineers' Rule 129 (1916 edition) the insulation resistance should be 30 megohms divided by 50 points, or 600,000 ohms; by the Board of Trade regulation the maximum current taken by the 50 20-watt lamps would, if supplied at 200 volts, be 5 amperes, or at 100 volts 10 amperes. One ten-thousandth part in each case, converted into figures of resistance, becomes for 200 volts 400,000 ohms, and if the supply is at 100 volts, 100,000 ohms; and these figures alone must guide the supply authority in connecting up or declining to connect up a new installation. Some systems of wiring necessitate one pole being permanently earthed; provided that a double wound transformer is used there can be no objection on the part of the supply authorities to such systems of wiring, all that they need test is the primary winding of the transformer, the wires and fittings do not concern them.

(*To be concluded.*)

SEIZURES OF DIESEL ENGINE PISTONS.

By EDWARD INGHAM, A.M.I.Mech.E.

One of the principal troubles in the working of Diesel engines is seizure of the piston. When it is remembered how small is the clearance between the piston and the cylinder liner in such engines, it is rather surprising that cases of seizure are not far more frequent than they appear to be.

It is common knowledge that in a Diesel engine small piston clearances are absolutely essential if a high efficiency and smooth running are to be obtained. The designer of the engine is confronted with the problem of reducing the clearance between the piston and the cylinder liner to within the smallest practical limits, without, at the same time, involving undue risk of seizure of the piston.

When seizure takes place, it is not difficult to realise that the results may easily prove disastrous; thus, if the motion of the piston be suddenly arrested, the energy stored in the fly-wheel tends to keep the crankshaft rotating, so that the crank exerts a severe pull on the connecting rod, with the result that the connecting rod or cross-head bolts are severely strained. Should the bolts fail, the consequences may be easily imagined. In one instance with which the writer is acquainted, where seizure of the piston caused failure of the cross-head bolts after elongating them and reducing their diameter from 1 in. to $\frac{5}{8}$ in., the connecting rod was badly bent, and fracture of the piston and the cylinder liner resulted. One of the nuts from the broken bolts dropped and fouled the crankshaft and the engine frame, and as a consequence, a piece of metal was broken out of the frame, whilst the crankshaft, which had four double-sweep cranks, was twisted evenly throughout its entire length, the angle between the first and the last crank being about 15 degrees.

This example will serve to show how disastrous may be the effects of a piston seizure.

In a general way, it may be said that seizures of Diesel engine pistons are mostly caused by over-heating of the piston, and the expansion of the metal which results. As already pointed out, the clearance between the piston and the cylinder liner must be extremely small. If then a piston expands much more than the liner, the small clearance is reduced to such an extent that the piston cannot move freely, and seizure is the consequence.

The tendency to seizure is, of course, aggravated by the fact that in the ordinary trunk-piston engine, where the piston is attached directly to the connecting rod, the forces imposed on the piston do not, as in the case of the steam engine, act in the direction of the axis of the cylinder. Owing to the obliquity of the connecting rod, a more or less severe side pressure is exerted on the cylinder walls, so that the motion of the piston is not as uniform and free as it otherwise would be.

Clearly, if the trouble under consideration is to be obviated, it is of fundamental importance that the temperature of the piston be prevented from rising too high. Hence the question of lubrication must receive the most careful attention. Not only the piston and the liner surfaces, but the piston pin and the top bearing of the connecting rod must be efficiently and continuously lubricated. With the horizontal type of engine, lubrication of the piston and the liner surfaces can be effected satisfactorily by a single feed on the upper side, since gravitation assists in distributing the lubricant, but with engines of the vertical type, which is the type mostly used, the lubricant must be supplied through a number of feeds, as many as four in the smallest engines if a thorough distribution of the lubricant is to be effected.

Lubrication of the piston pin and the top end bearing is effected in different ways, which we need not consider here. Special care should be taken to ensure that the pin will be thoroughly lubricated at starting times.

When an engine is shut down, the heat radiated by the piston, pin, &c., has a tendency to burn up the lubricant in the top end bearing, so that when the engine is again started, the lubrication of the bearing may be deficient. Over-heating of the pin and the piston may then result, involving considerable risk of seizure. The great majority of piston seizures appear to have been brought about in this way.

With the object of preventing over-heating, some pistons are cooled by means of water or oil, and this is an effective method of reducing the risk of seizure, provided the circulation of the liquid is maintained.

The design of the piston is a factor of considerable importance in regard to this question of piston seizures. It must be such that the liability to distortion will be reduced to the minimum, since a very slight amount of distortion may lead to seizure. The design must also be such that expansion will take place uniformly all round the piston. There should be a good body of metal, as this will assist in the escape of the heat transmitted to the piston. Special attention should be given to the question of avoiding initial strain during casting, which might lead eventually to fracture. A fracture in a diametral direction would be especially liable to cause a seizure. It is common knowledge that most

Diesel engines are of the trunk-piston type, but Messrs. Mirrlees, Bickerton & Day, of Stockport, have introduced a cross-head type of engine. This type of engine is far less liable to piston seizures than the ordinary type. The provision of a cross-head, slides and piston rod, results in the piston's moving truly and freely in the direction of the axis of the cylinder, so that side thrusts are obviated. For this reason alone, the cross-head type of engine is an improvement over the trunk type, but there are other reasons. The connecting rod top end bearing, instead of being in the cylinder, where the heat is intense, is well away from the cylinder; hence there is less liability for the bearing and the piston to become over-heated. Further, the engine is provided with forced lubrication, so that every bearing is continuously flooded with oil. A small hand pump, which is fitted in connection with the lubricating system, enables all the pipes and bearings to be primed with oil just before starting up, and in this way, all bearings are copiously supplied with the lubricant from the commencement of the running.

Many piston seizures are to be attributed to the use of cooling water containing lime and magnesium salts. When there is a large quantity of these in solution in the water, the salts are liable to become deposited in the narrow water spaces, involving risk of overheating and fracture. The practice of allowing water to circulate for some time after the engine has been shut down will tend to prevent the deposition of the solid matter, which is mainly due to the increase in the temperature of the stationary water which takes place when the engine is stopped and the heat in the metal walls in transmitted to the water.

It will, of course, be understood that the tendency to piston seizures will be aggravated by overloading the engine, or by running it for prolonged periods, whilst lack of attention on the part of the attendant will also increase the tendency.

A PROGRESS MANAGER'S FIRST TALK WITH FOREMEN.

By W. J. HISCOX.

Gentlemen,—I have come into this factory, a stranger to you all, with one object in view—to facilitate progress so that, as nearly as possible, the maximum output is obtained. It has been recognised by your management that something is lacking; that, no matter how hard you work, the result does not come up to expectations. It has, therefore, been decided to introduce into the business a progress manager, a man who is prepared to overhaul and amend the existing organisation, with a view to giving you every facility for extending the production of your several departments, and ensuring that all the enterprise and all the effort you put into your work are taken advantage of, and not allowed to deteriorate through inefficient organisation.

It casts no reflection upon your ability or upon your enterprise that the management has decided upon this course. On the contrary, it has been recognised that too much has been expected of you in the past; that you have extended yourselves more than should have been necessary, in the endeavour to minimise, as much as possible, the ill-effects of faulty and defective organisation. The appointment of a progress manager, therefore, is as much in your interest as in the interests of the firm, for he will relieve you of all administrative and other duties not strictly within your purview, and that will enable you to devote your whole time to the supervision of your department, and to the problem of economical production, commensurate with the capabilities of your department.

That is your legitimate duty, and it will not be interfered with. Each one of you is, or should be, an expert in the particular line of business under your control. My business is to tell you what is required, and not how to meet those requirements. That is your affair. I can tell you what is expected of your department. You have to realise those expectations, or demonstrate, to the satisfaction of the management, that those expectations are impracticable.

In this connection I shall be the critic of the factory. I shall criticise (on behalf of the management) any department which, in my opinion, is not laying itself out to meet its commitments, and it will be up to you to disprove my statements. Such criticism will be quite impersonal, and utterly devoid of animosity. It will be actuated solely by the exigencies of production, which claims from you, as from me, every consideration. Calculations will not be based entirely upon theory, for it is recognised that shop conditions constitute a most formidable factor. Every consideration will be extended, and with the elimination of many of the vexatious details which in the past have had an adverse effect upon departmental efficiency, it is reasonable to hope that the working conditions will materially benefit.

Although, as may be expected, I shall be more directly interested in certain departments, my views will be directed to the broad aspect of progress. Being concerned with output from the factory, I look upon the factory as one huge department, and the departments as units, each of which excites my interest in proportion to the bearing it has upon the output of the factory. I am not prepared to extend preferential treatment to those departments which, in the eyes of the foremen, are my direct concern. On the contrary, I shall welcome your criticism, and I should certainly not take a lenient view of the act of any person within those departments which was calculated to affect adversely the efficiency of any other department.

During the short time I have been here, one fact at any rate has forced itself upon my notice, viz: That in this, as in every other factory where similar conditions prevail, the foremen and the administrative staff are at loggerheads, each side blaming the other for the unsatisfactory state of affairs existing. Taking it for granted that the organisation sadly needs improving, I am going to exercise my prerogative and criticise the foremen for what, in my opinion, is their contribution toward the present state of affairs. You will think this is decidedly premature, and I know that your method of answering will be by retaliation. I will, however, anticipate your answers, which will be somewhat on these lines:—

At the outset you will retaliate by telling me to put my own house in order. You will point to the imperfect organisation which exists; the blunders and the delays consequent upon the inefficiency of the stores and progress. You will tell me that, had you been content to remain strictly within the confines of your legitimate duties output would have suffered, machines could not have been kept running, and costs would have considerably increased, on account of the maintenance of partly employed mechanics. You will tell how you grubbed about for work, how you explored the stores, and discovered undreamed-of possibilities; how you invaded other departments and other sections, and actually carried work across to your own department rather than incur a delay by waiting for the parts in question to pass through the usual routine. You will tell me that, so far from you contributing to, or being responsible for, the present undesirable state of affairs, you actually went out of your way to combat it, and that the responsibility must, to a very large extent, be shouldered by the departments I most directly represent. To this I am bound to say that I agree with you.

It is, however, to raise these departments to a high degree of efficiency that I want your help. I want to study your existing system, and to consider its weak points. I want to find out where the system fails, and why it fails, and if possible to remedy the defect. To do this, however, I must have the co-operation and goodwill of the foremen. They must accept the fact that I am here to be of assistance to them, and I want them to realise that I *can* be of assistance to them. That is why I criticise. Criticism is the finest thing in the world to make a man tell what he knows. Take a police court case. The prosecutor (or the defendant) goes into the box and tells his story. He is then cross-examined by the opposing counsel, and it is really surprising what different points are brought to light—points which were wholly neglected (or only lightly dwelt upon) in the straightforward evidence. The evidence is the bald outline of the facts as they appear to the interested party. The cross-examination elicits the details, which may put a different complexion on the whole matter. So it is with criticism. The story of the administrative staff and the story of the foremen are diametrically opposed, but criticism reveals virtues and faults on both sides, so that the adjustment of the differences becomes a much simpler proposition.

Having gained (as I hope) the goodwill of the foremen, I will deal with the question of putting my own house in order, and at the same time endeavour to show to what extent the foremen are retarding that very desirable consummation. Taking, for the purposes of illustration, the stores department as the house to be put in order, I will first of all ask you to imagine yourselves in the position of a stores official.

You would find yourselves in a department catering for the needs of the entire factory. You would speedily discover that facilities for ensuring rapid progress were entirely lacking; that there was not sufficient accommodation for the volume of work pouring into the department, and that the class of labour you had to depend on was not by any means Grade I. On account of the inadequate accommodation you would be obliged to house a portion of the work in temporary structures, and, although a correct record of the parts in question may be available, the chances are that many of them would be missing when required. Foremen

and charge-hands, intent only upon the needs and interests of their own departments, would bombard you from morning till night; before you could get away on one job someone else would be cursing because you were not in a position to satisfy his needs at the moment. Work must be had for the shops, and the operators will not wait, for that would mean losing money. At the same time, work must be received into the stores, checked, and signed for, and there must be no delay here, otherwise the operator may have to wait another week for his bonus.

You cannot find this, and you cannot find that, so the foreman comes in to help you. He discovers something which will suit him just as well, so he takes a few of the articles away with him to make a start upon. As soon as possible you send the material out, without remembering, or perhaps without knowledge of, the few parts the foreman walked away with, and at a later date the cry is raised that the records do not tally with the actual stocks.

You get work into the shops, and some days afterwards you are informed that this part and that part is missing. You protest that the correct quantities were issued, but your protests are cut short by the foreman, who politely tells you that progress is being retarded, so you hand him a few extra articles, and again wonder in a few weeks' time why records and stocks do not agree.

Having experienced this (in imagination), does it not occur to you, as foremen, that you could do much to alleviate the troubles of the stores official? I do not want you to help him inside his department, but outside; and if I am to put my house in order I must have your co-operation and sympathy outside. A man digging a trench does not make much progress if someone on top will persist in shovelling the earth back again. And now to put the house in order—with your help.

In the first place, you will remain outside the stores. It may inconvenience you for a little while, but you will feel the benefit later on. The stores official must work out his own salvation inside. It is his responsibility to meet your requirements within a reasonable time; but he must be given reasonable time. Everything cannot be supplied on demand; there must be time for preparation. Parts must be located, taken down, counted, and the necessary documents made out—and all this takes time. Every foreman knows (or should know) when he is likely to require work, and there should be no difficulty in every foreman giving the stores from, say, one-half to two days' notice (according to the magnitude of the order) that material is required.

When once the whole of the items comprising any specific order have been delivered to the shop, and accepted as correct by the foreman, it must be understood that the liability of the stores, with regard to quantities, &c., ceases. It has often happened that an operator is unable to find a certain article required in connection with the order, so, obtaining a requisition from his foreman, he presents this to the stores, and obtains a replacement. This procedure is adopted upon the slightest pretext, and it does not tend to improve the working of the stores. The complaint of the operator is that short quantities are issued from the stores, and further supplies are demanded. It may be that an article is scrapped, or mislaid, and if extra parts are issued from the stores at any time at the behest of the foreman, it is obvious that surplus parts will accumulate in the shop. Periodically, these are collected and returned to the stores, thereby throwing all records out of gear, besides incurring the risk of scrap parts being treated as good stock.

It is desirable to make it as hard as possible to get extra parts from the stores, without actually retarding progress, and it is proposed, therefore, that all cases of this description shall be dealt with by the inspection department. If a part is scrapped in the shop, and needs replacing, or if it is unsuitable, and needs rectifying, the article, together with the foreman's report, will be sent to the inspection department. The inspector will examine the part in question, and make out his report, which will be sent to the stores. It can then be dealt with in an intelligent manner. If an article is missing, the foreman of the department handling the order must be held responsible, and an inspector's report to this effect must be sent to the stores before a replacement can be issued.

All material sent into the stores, from whatever source, must pass through the inspection department before being accepted into stock. Several instances have occurred where scrap material is kept in stores as good stock, and this must be eliminated. It must be remembered that the storekeeper is not an inspector, and he has the right to assume that every article passing into the stores is good stock.

These proposals will not doubt throw extra work upon the inspection department, and also (for the time being) upon the foremen of other departments. It is in this direction, however, that I want your help, in order to facilitate my task of reconstructing the stores. This is my first duty, and when once accomplished the ground will be ready for the application of a general progress system.

I have outlined the first phase of my reconstruction scheme, and the help I require from you. The first duty of a progress manager is to ensure that production shall not suffer during the reconstruction period, and if I can rely upon your support I am confident that in a very short time the whole factory will derive an advantage.

SURFACE CONDENSING PLANT FOR LARGE POWER STATIONS.

By R. J. KAULA, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

In most condenser calculations it is assumed that the heat quantity to be absorbed by the cooling medium is the latent heat of the steam corresponding to the pressure of condensation.

Table I gives the heat units rejected to the condenser per lb. of steam for a few typical initial steam conditions and turbine efficiencies, on the basis of an exhaust pressure of 1 lb. absolute. It will be seen that under the more usual conditions the latent heat slightly exceeds the actual value to be dealt with, so that there is a corresponding margin in hand. Since, however, most constants derived from test results make no allowance for this difference, it is the more important that a correction should be introduced where the heat units exceed the latent heat figure. The specific heat of the water is taken as unity, regardless of its consistency and temperature. On these assumptions, the quantity of cooling water required per lb. of steam to be condensed is, in lb.—

TABLE I.

Steam inlet. Pressure, lb. per sq. in. abs.	Steam inlet. Superheat, deg. F.	Turbine efficiency, per cent.	Heat units rejected, therms.	Latent heat, therms.
300	250	80	1,006	1,043
200	200	75	1,028	1,043
150	100	70	1,017	1,043
150	100	65	1,035	1,043
14·7	0	60	1,051	1,043

$$W = H/(T_2 - T_1) \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

where H = latent heat in therms, T_1 = cooling water inlet temperature in deg. F., and T_2 = cooling water outlet temperature in deg. F.

The difference t_2 between T_2 and the temperature of the steam at the pressure of condensation T_0 is, to a large extent, a measure of the efficiency of a condenser. Whilst test results frequently show t_2 as low as 5° F., it is well to estimate on 8° or 9° F., so as to ensure an ample margin of cooling water under all conditions of working.

The amount of surface area to be allowed for a given duty of condensation is given by the formula—

$$S = Q\,H/T_m\,K \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

where S = cooling surface in sq. ft., Q = quantity of steam to be condensed per hour in lb., H = latent heat at pressure of condensation in therms, T_m = mean temperature rise in deg. F. $= (T_2 - T_1)/\log_e [(T_0 - T_1)/t_2]$, and K = heat-transmission coefficient in therms per sq. ft. per hour per deg. F.

Since t_2 is usually predetermined and the remaining factors in the formula are fixed, as conditions to be attained, S may be said to vary inversely as K. Until comparatively recently K was taken at a figure varying from 300 to 500. But it has been proved that K for a given condenser design varies distinctly with the cooling-water velocity V. For values of V ranging from 3 ft. to 6 ft. per second, K may be taken as a function of the square root of V. For lower velocities the rate of variation is, no doubt, greater owing to the almost entire absence of turbulence, and for higher velocities the curve flattens out somewhat. If therefore the surface is increased to obtain a margin, this will only be fully effective provided that the water velocity is maintained. K is also dependent on efficient air extraction and on features of general design, so that the bare measure of the tube area presents no gauge of the margin available.

The degree of dryness of a tube is known to have a material effect on its heat-transmission coefficient, and it follows that in this respect the tubes nearest to the steam-inlet opening are more effective than those placed lower down, which may be assumed to be coated with a water film.

The more recent development of condenser design tends to reduce the drop in pressure across the tube nests to a minimum, notably by means of ample steam lanes, and this helps to provide a maximum number of tubes within what may be termed the dry zone. The provision of steam baffles in the tube space has now been entirely abandoned as being harmful rather than otherwise. On the other hand, guide vanes in the steam inlet opening are frequently introduced to assist the initial distribution of the steam.

The ratio of length to diameter needs to be kept reasonably low

to avoid the formation of dead pockets at either end of the condenser, and a practical working limit for L/D may be taken at 2, whilst a value of 1·5 should be aimed at.

In surface condenser design for land work, the direction of the flow of the water is opposite to that of the steam. With wet-type air pumps using the condensate as sealing water, this system is practically a necessity, but since the majority of modern plants use dry pumps, this point does not require the same consideration, and the higher condensate temperature obtainable with a parallel-flow condenser would be a decided advantage.

The advantage to be derived on a siphonic circulating-water system by adopting the parallel-flow principle reaches a substantial amount where the distance from water level to the highest point of the system is considerable. On the other hand, the reduction in siphonic vacuum to be maintained on a low-head system is in itself a considerable advantage.

It is not suggested that the parallel-flow principle possesses such advantages as to warrant its general adoption, but there would appear to be good grounds for its use on siphonic circulating-water systems.

As far as the user is concerned, there is little to choose between cast-iron and wrought-steel shells. Cast-iron shells are considered liable to crack when the turbine is changing from atmospheric

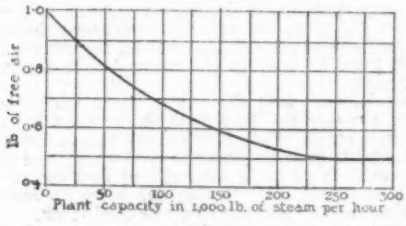

Fig. 1.—Curve Showing lb. of Free Air at Atmospheric Pressure and at 60° F. per 1,000 lb. of Steam.

exhaust to vacuum, and *vice versâ*. On the other hand, wrought steel is liable to corrosion. As a matter of experience, the author has not heard of a single instance where a cast-iron shell has actually cracked, except in the course of manufacture. It seems unlikely that cast iron will prove economical in peace time for sizes of, say, 20,000 sq. ft. and upwards.

In land practice the water velocity in the tubes varies usually between limits of 4 ft. and 7 ft. per second, depending on the permissible friction loss and the attaining of a suitable shape for the condenser. The friction loss varies with the square of the water velocity, and may be divided into the following items :—

Loss in the tubes themselves	I
„ at tube inlet and outlet	II
„ in the water-boxes and inlet and outlet branches ...	III

Whereas I is simply determined by the diameter and length of tube selected, II and III will vary according to the care exercised by designers and draughtsmen. By providing suitable bellmouths on the ferrules a saving can be obtained on II without materially adding to the cost of production. Sharp right-angle bends at the inlet and outlet branches should be avoided wherever possible, especially at the inlet, as the waste in friction head may reach quite a substantial figure.

The quantity of air to be dealt with depends on the number and condition of joints under vacuum, on the air-tightness of the turbine glands, and on the quantity of air carried over with the steam. Since the peripheries of the joints and glands vary approximately as the square root of the output of the plant, the quantity of air to be allowed per lb. of steam condensed should be materially less on a large unit than on a small one. The variations in air-pump capacity called for in purchasers' specifications indicate a considerable divergence of opinion as to what constitutes a reasonable allowance in this respect. It would seem very desirable that some form of standard should be established, to which all condenser makers could work, and the curve shown in fig. 1 is put forward as a suggested basis for high-pressure turbine plant where the condenser is mounted immediately below the turbine. It is naturally important that the air-pump capacity should be ample; at the same time, an excessive margin means a continuous waste of auxiliary power.

Modern types of air pumps can be divided under three headings :—

1. Reciprocating pumps.
2. Rotary air pumps.
3. Steam ejector pumps.

The Edwards pump is the only example of the first group which can still claim to hold its own even in the largest installations, but where vacua of over 27½ in. to 28 in. are concerned it may be ruled out, except in conjunction with a vacuum augmentor. Its comparatively low power consumption, reliability, and low maintenance cost are its chief advantages. Where a vacuum augmentor is in use the steam consumed by the jet requires to be added to the pump power consumption, and in practice this amounts to anything from 0·5 to 1 per cent. of the main turbine consumption, whereas the pump itself should not consume more than about 0·2 per cent. of the turbine power. The disadvantages of the Edwards pump are its bulk and its low running speed, and where the pump uses the condensate as sealing water the temperature of the latter needs to be kept low, and the condensate becomes strongly aerated—a frequent source of boiler troubles.

All rotary types of air pump consist of one or more water jets, which entrain and compress the air. In the case of the kinetic system, the water jet works in series with a steam jet. The efficiency of such pumps is still very low.

The steam-ejector type of air pump represents a development of the Parsons vacuum augmentor. In simplicity it equals the water-jet type, with the advantage of using pipes of small dimensions instead of comparatively heavy water pipes. There can be little doubt that the claims of the steam ejector are strong enough to ensure its success and widespread application.

The failure of an air pump does not in itself involve an immediate change to atmosphere, as the consequent accumulation of air in the condenser is very gradual where the system is reasonably air-tight. Provision should therefore be made, where necessary, by means of suitable non-return valves, to ensure that such a failure is not accompanied by an inrush of air through the air pump.

The introduction of rotary air pumps brought in its train the general use of separate condensate pumps. The conditions to be met are such as to impose the utmost difficulty on the design of a pump of the centrifugal type, and much practical experience had to be gained before satisfactory designs were evolved. Low water velocities on the suction side are essential, as well as in the impeller, to guard against cavitation troubles. To ensure these conditions, and stability over the large range of fluctuating loads which such pumps are called upon to handle, it is well to work on the lower part of the pump characteristic, well below the point of maximum efficiency. Since the total power involved is small, the question of efficiency is not of material consequence.

An ample static head on the suction side is required to overcome pipe friction and to ensure that the water enters the pump with a sufficient initial velocity. The connecting pipes between the condenser and the pump should be as short as the lay-out will permit, with a minimum number of joints. Unfortunately, the same reasons for inserting non-return valves on the suction side apply to condensate as to air pumps.

The circulating pump forms a vital link in the chain of apparatus that constitutes a condensing plant, as regards continuity of running, since its failure for however short a period means an immediate and complete failure of the vacuum. Relinability is therefore naturally a first consideration. At the same time the power consumption is comparatively high, so that a high efficiency needs also to be looked for.

Since all but the smallest circulating pumps are of the double impeller type, balancers are not usually needed. It is, however, advisable to avoid pipe bends in the horizontal plane in close proximity to the suction inlet, as they are apt to produce an uneven distribution of the water over the two halves of the impeller and to throw the pump out of balance. Even when the

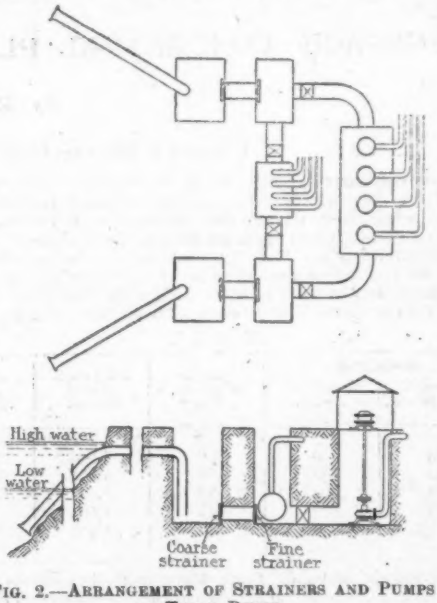

Fig. 2.—Arrangement of Strainers and Pumps on Tidal River.

water levels are constant, provision should be made for reasonable variations in head. Regulating the water supply, according to the head, by varying the pump speed is much to be preferred to throttling.

In large power stations it is customary to provide separate turbo-generating units for supplying the power to all auxiliary machinery, and for lighting purposes, so as to ensure complete independence of the main plant. There is nothing to choose between three-phase and direct-current supply for this purpose, but the possibility of obtaining speed variation is a marked advantage in favour of the latter system, and this applies particularly to the circulating pumps.

In smaller stations not provided with such auxiliary units, the necessity of starting up on atmosphere after a complete shut down,

where electric motors are used for driving the condenser pumps, has led to the extensive adoption of steam turbine-driven pumps. Coupling the three pumps to a single turbine has considerable drawbacks. It seems preferable to drive the condensate pump electrically, particularly since the plant can be started on vacuum with this pump standing.

If the steam consumed by the combined air and circulating pumps is excessive for feed-heating purposes, as, in fact, is usually the case, it becomes necessary to provide separate drives for the two pumps, or to build the auxiliary turbine of the pass-out type. Such steam as cannot be utilised in the feed heater can either exhaust into the condenser or into the low-pressure stages of the main turbine.

The former system is rather extravagant in steam consumption, although where gear driving is adopted it is quite possible to obtain a very fair efficiency in turbines of 200 to 300 H.P. and upwards. If the auxiliary turbine exhausts into the low-pressure stage of the main turbine, the economy will be found to be about equal to that obtained with electric driving, but the complications which this introduces into the construction of the main turbine are undesirable, and additional steam space is required in the low-pressure blading just where it is hardest to obtain.

Since, apart from a limited amount of saving that can be obtained at lighter loads by speed regulation or throttling, the power consumed by the condenser auxiliaries represents a constant loss, their most economical arrangement deserves the closest attention.

In a modern power station, where the water quantity to be dealt with amounts to hundreds of thousands of gallons per minute, the means of handling the water is a primary consideration in the design and lay-out of the engine house. In the case of a non-tidal riverside station, where the river level coincides with the condenser basement level, the most satisfactory plan is to allow the water to flow by gravity in an open concrete duct into the engine room, with branches leading from the main duct to each pump, the latter being placed close to the condensers. The discharge pipes from the condensers should be led into a corresponding outlet duct, in which the water is maintained at a sufficient level to enable it to return to the river by gravity. A similar arrangement can be adopted in a cooling-tower station, if separate pumping plant is provided alongside the towers to deliver the water to the top of the towers. This arrangement of separate pumps makes it possible to adjust the number of towers in use according to the atmospheric conditions and independently of the number of condensers on load. Where the water-level conditions prohibit the use of open ducts, it is preferable in large stations to run separate pipe lines for each unit.

Perhaps the most difficult condition to be dealt with is that of a tidal river containing large quantities of solid matter which require to be strained before the water enters the condenser. Fig. 2 shows a diagrammatic arrangement of strainers and pumps to deal with such conditions. The water is siphoned from the river into a strainer chamber, and passes from there through two sets of grid strainers into a clean-water chamber, and then to the pump house. The strainer chamber and clean-water chamber are duplicated, so that the flow of water may be reversed for the purpose of clearing the strainers, and at the same time to prevent silting of the main pipe inlets. The discharge pipes from the condensers are led into a discharge chamber, their outlets being below water level. Valves are shown between the clean-water chambers and the pump house and discharge chamber to give the required reversal of flow. In smaller plant, and where no great difference in water levels has to be dealt with, strainers of the endless-chain type, with water-jet cleaning gear, as first introduced by Messrs. Dickinson and Porter at Leeds, are generally effective. So-called revolving strainers, such as the Bailey and Jackson type, are too cumbersome for large plants, and the inevitable leakage loss is a considerable drawback to their use.

Under modern conditions a condenser designed for a vacuum of 28½ in. (Bar. 30 in.) with cooling water at 70° F. will still be capable of maintaining a vacuum of 27 in. if the cooling-water quantity and surface are halved, and when dealing with the same quantity of steam. If therefore a condensing plant is arranged to consist of two condenser bodies with separate water connections and valves, it is possible to open up the water side of one condenser at a time for cleaning purposes, and to continue running at approximately full load without a heavy loss of vacuum. It is, of course, not possible to remove tubes under such conditions, as the inactive condenser remains under vacuum. Naturally, such an arrangement means a substantial increase in first cost, greatly complicates the general lay-out of the whole plant, and can only be justified where the water conditions are exceedingly poor.

Discussion in London.

Mr. E. Bailey, opening the discussion, said that unfortunately the time had not yet come when standardisation could be accomplished. What they really were in need of was some plant at the minimum cost and operating with the minimum amount of water, but at the same time highly reliable. A striking point was the large variation in power that was required for the different systems. He was in agreement as to the difficulty of removing debris from the water; with regard to the author's arrangement of strainers and pumps to deal with a tidal river containing large quantities of solid matter, he did not think it was a practicable arrangement if the water was dirty, although it might work well with clean water. With dirty water, he thought in such an arrangement the flow would have to be reversed as often as once in five minutes if it was to work properly, and that was out of the question. The suggestions made by the author concerning the so-called rotary strainer associated with his name were hardly warrantable he thought. Strainers 6 ft. in diameter could now do the same work as those formerly 8 ft. in diameter, and the leakage loss had been reduced from 15 per cent. to 2 per cent. The device was being constantly improved, and he had hopes of it being standardised in the near future. The author had made some good suggestions regarding the aeration of the condensate; that subject had not been considered sufficiently in the past, and he looked forward to much improvement in this respect.

Mr. W. B. Woodhouse thought the paper full of sound practical advice, and he was in full agreement with it. On account of corrosion difficulties he was personally in favour of cast-iron being used for large shells, even if such shells had to be made in sections. With regard to screening the water, he thought that operation was best done in stages through finer and finer screens. In his opinion stoppage for the purpose of cleaning condensers should not be necessary; surely some means could be evolved by which cleaning could be carried out while the condenser was at work. He was in agreement with the author's remarks as to what constituted a reasonable allowance in air-pump capacity. The variations called for in purchaser's specifications were very large, and capacities much lower than those called for were found to be ample. Standardisation in this respect would be very useful. With regard to air-extraction devices, steam-jet extractors were the right things to use; it was logical to suppose that the best means of entrapping a gas was by means of another gas. Such extractors worked extremely well, they were simple, and they eliminated a piece of rotating machinery. Corrosion was a very complicated problem, it occurred in all sorts of places. He suggested that variable speed pumps might have certain advantages, but perhaps they would not be considered worth the extra complication.

Mr. G. W. Partridge congratulated the author on his paper, and said he was in agreement with the sentiments expressed therein. In his opinion, it was very important to sub-divide the plant, and he agreed with the previous speaker about having to shut down for cleaning purposes. Personally he would like to see two condensers for each turbine, but that might not be always possible on account of the space taken up, &c. The question of water velocities was one of importance; he had found that velocities varied very much. In America it was the practice to keep the velocity at about 9 ft. per second, which was said to help clean the condensers. From the point of view of reliability, the driving of auxiliary plant was most important. Assuming electrical driving, whether it was A.C. or D.C., there should be, in his opinion, three separate sources of supply to the auxiliary plant. One of these sources should be a separate generator entirely independent of the main-station generators or bus-bars. The three sources of supply would be normally connected in parallel with automatic change-over switches to operate in case of failure of one source of supply. He could not say that he was in love with the author's arrangement of pumps and strainers to deal with water from a tidal river which contained solid matter. By means of diagrams he illustrated the layout of the pumps at Deptford, and also a strainer designed by one of his assistants. The pumps were kept running at full speed and capacity pumping into a bus pipe, from which the water was delivered in turn to the condensers, thus forming a very flexible supply. The strainer was a rotary one, comprising a perforated gun-metal cylinder rotating against a scraper. The water was led in from the outside and discharged from the inside of the cylinder. Such strainers had given satisfaction for a number of years.

Mr. E. R. Briggs said that much work had been done during the last six years in the subject of heat transmission, especially in the U.S.A. The difficulties of carrying out proper tests were very great, such tests could not be obtained under running conditions. The water velocity had a large effect on heat transmission; in the U.S. they had now abandoned velocities of 9 ft. per sec., and considered 5 ft. sufficient. The question of water flow in large condensers was of importance. The firm with which he was connected was now building a large condenser which had in place of one water box, two boxes of stream-line construction so that the water on entering and leaving encountered the least possible friction. He thought the author's arrangement of strainers and pumps was wrong, because it would be found very difficult to keep the pipe lines clean and airtight. Further, the screens and pumps were drowned, and were not accessible.

Mr. I. V. Robinson thought the author would have done better had he used the more usual symbols in his formulæ; he had used too many T's, which might lead to confusion. With regard to large condensers, he thought that manufacturers would prefer shells to be smaller in diameter as compared with length. The cost increased more with the diameter than with length. Personally, he preferred steel shells, and he thought the reason why these had not been more generally adopted was that all manufacturers had not got the shop facilities for their manufacture. He thought it was probable that makers would prefer the sub-divided condenser as it was easier to make two shells in place of one large one. With regard to extraction pumps, he said the Edwards pump was a back number, although it had the advantage of simplicity, and was easily understood; it was not everyone who understood steam jets and how to use them. In his opinion, air capacity would be considerably reduced in the near

future; at present they were over-estimating the amount that was necessary. The closed condensate system was the correct one to use; the less amount of air that came in contact with the water the better.

Mr. C. C. Paterson, O.B.E., agreed with Mr. Partridge's statement that for every lb. of coal burned 500 lb. of water were required. In the course of experiments on the cooling of a cylinder with water, he had found that only the outside of the column of water became heated, and the centre was often cold. When turbulence was introduced, however, the amount of water required for cooling was materially reduced, and he wondered whether the condensing water could be reduced in a similar way.

Mr. R. J. Kaula, in reply, said that corrosion was difficult to deal with, and sub-dividing the condenser would introduce complications which might off-set the advantage gained thereby. In his opinion, all large condensers would be built *in situ*. It was a pity to sacrifice speed regulation if it could be helped in driving auxiliaries. With regard to water velocities, he thought that about 6 ft. per sec. would be found economically sufficient.

NEW PATENTS APPLIED FOR, 1918.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sexton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

7,981. "Machine for winding magneto armatures, coils, &c." R. W. Humphrey. March 31st.

8,060. "Electric fires." H. H. Barry & J. W. Reid. March 31st.

8,063. "Dynamo-electric machines." W. A. Price. March 31st.

8,083. "Dynamo-electric machines." British Thomson-Houston Co. (General Electric Co., U.S.A.) and A. A. Pollock. March 31st.)

8,084. "Electric transformers." British Thomson-Houston Co. (General Electric Co., U.S.A.) March 31st.

8,085. "Machines for manufacture of electric incandescent lamps, &c." British Thomson-Houston Co. (General Electric Co., U.S.A.) March 31st.

8,106. "Locking-off switch for magnetos and accumulators on motor cars, &c." R. Cornwall. March 31st.

8,127. "Electric contact-makers." E. Marples. April 1st.

8,128. "Electric lighting systems for motor vehicles." E. Morris. April 1st.

8,133. "Electrical fuses." A. C. Wynne. April 1st.

8,146. "Head attachments for telephones." R. Rostron. April 1st.

8,151. "Electric bells." R. E. Ducie. April 1st.

8,154. "Electric immersion heater." P. H. Lamplough. April 1st.

8,156/7/8. "Telemotors." A. E. Alexander (Benson Electric Co., U.S.A.). April 1st.

8,163. "Telephonic repeaters." R. M. Chamney & C. Robinson. April 1st.

8,164. "Miners' electric lamps." E. H. Naylor & S. F. Tyler. April 1st.

8,172. "Electric light switches, bell pushes, &c." W. Hinds. April 1st.

8,175. "Electric coin-operating bioscope." J. M. Davey & S. M. Green. April 1st.

8,177. "Systems of electric power transmission." British Thomson-Houston Co. (General Electric Co., U.S.A.) April 1st.

8,179. "Utilisation of high-frequency alternators in radio-telephony." Soc. Francaise Radio-Electrique. April 1st. (France, October 28th, 1917.)

8,198. "Electrode of perforating metal plates, &c." C. J. Holsgag. April 1st.

8,200. "Multiple-control apparatus for electric railways with motor-driven main switch drums." Akt. Ges. Brown, Boveri et Cie. April 1st. (Switzerland, May 3rd, 1918.)

8,208. "Magnetos." Soc. H. Arguembourg Joret et Cie. April 18th. (France, April 3rd, 1918.)

8,213. "Electrical time switches." E. Schattner. April 1st.

8,222. "Means for fastening ends of wires, rods, &c., to terminals." T. F. Stent. April 1st.

8,246. "Electrical resistance for electric lighting, &c." A. W. Rayworth. April 2nd.

8,257. "Electric welding." F. J. Heyes. April 2nd.

8,278. "Dynamo-electric machines." R. W. Myers. April 2nd.

8,286. "Holders for wireless detecting crystals, &c." W. P. Thompson (V. J. Brochard). April 2nd.

8,292. "Spark plugs." S. Fisher & W. Priddey. April 2nd.

8,312. "Systems of electric power transmission." British Thomson-Houston Co. (General Electric Co., U.S.A.) April 2nd.

8,324. "Electromagnets." S. F. Barclay & Vickers, Ltd. April 2nd.

8,337. "Sparking plugs for internal-combustion motors." F. Beck. April 2nd.

8,352. "Electrical resistance elements." H. Wade (J. Thomson). April 2nd.

8,376. "Electrical fuses." H. F. McLoughlin, Simplex Conduits, Ltd., and L. M. Waterhouse. April 3rd.

8,388. "Electro-magnetic devices for alternating currents." G. H. Neep, D. H. Ogley and Switchgear & Cowans. April 3rd.

8,432. "Electrically-driven compressing apparatus." C. Melano (Borgarello). April 3rd.

8,441. "Magnetos." A. E. White (Webster Electric Co., U.S.A.). April 3rd.

8,448. "Receiving methods of radio-telegraphic and radio-telephonic signals." C. Bardeloni. April 3rd. (Italy, October 3rd, 1916.)

8,449. "Machines for manufacture of bobbins for electric batteries." National Carbon Co. April 3rd. (U.S.A., October 1st, 1917.)

8,463. "Lighting electric lamps of bicycles." C. J. Hamilton. April 4th.

6,478. "Sparking plugs." G. H. Barraclough. April 4th.

8,529. "Manufacture of electrothermic devices." P. F. Zimmerman. April 4th.

8,550. "Storage batteries." P. D. Ivey & A. J. Salisbury. April 4th.

8,551. "Drain devices for storage batteries." P. D. Ivey & A. J. Salisbury. April 4th.

8,560. "Rotors for electric motors, &c." P. F. Brittain. April 4th.

8,563. "Switchgear for electro-magnetic wave transmission and reception systems." P. P. Eckersley. April 4th.

8,573. "Insulated electrical conductors." British Thomson-Houston Co. (General Electric Co., U.S.A.) April 4th.

8,575/81. "Radio-telegraphy transmission systems." W. J. Mellersh-Jackson (A. Taylor). April 4th.

8,578. "Electrical systems." Domestic Engineering Co. April 4th. (U.S.A., April 6th, 1918.)

8,580. "Oscillographs, &c., and their application to radio or submarine telegraphy." A. Blondel. April 4th. (France, April 4th, 1918.)

8,601. "Electric relays or contact-makers for mine signalling apparatus, &c." J. R. L. Allott & E. Dean. April 5th.

8,608. "Electrical resistance devices." C. L. Browne & S. H. Heywood and Co. April 5th.

8,609. "Cable conduits for electric travelling cranes." C. L. Browne and S. H. Heywood & Co. April 5th.

8,642. "Carbon conductors for electricity." H. Wade (J. Thompson). April 5th.

8,649. "Dynamo-electric machines." British Thomson-Houston Co. (General Electric Co., U.S.A.) & F. H. Clough. April 5th.

8,650/1. "Station sets for intercommunication telephones." R. L. Murray. April 5th.

8,652. "Driving mechanism for selector arm of automatic selector switches." R. L. Murray. April 5th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1915.

13,899. Apparatus for use in wireless telegraphy and the like. Sueter, Groves & Binyon. September 30th, 1915.

14,071. Apparatus for the detection of sounds generated at a distance by means of ground vibrations. Gardner. October 5th, 1915. (Cognate application, 17,010/15.)

14,473. Submarine signal sound-receiving apparatus. Davison. October 13th, 1915.

14,474. Submarine signal sound-receiving apparatus. Davison. October 13th, 1915.

15,245. Apparatus for locating submarine and other boats by auditory vibrations. Padstore, Beaver & Claremont. October 28th, 1915.

15,320. Means for detecting and locating subaqueous sounds. Sykes and Morris. October 30th, 1915. (Cognate applications. 5,084/15 and 6,700/16.)

15,635. Instrument for ascertaining the tensional stress in flexible members, such as aeroplane stays, electric current-carrying wires, or other like stressed members. Avery, Ltd., & Gibbs. November 5th, 1915.

1917.

19,170. Electrolytic preparation of metals or alloys in the form of paste or sludge. B. Leech and H. & L. Slater. December 28th, 1917. (124,006.)

1918.

2,602. Automatic starting and stopping devices for electrically-driven air compressors. British Thomson-Houston Co. & J. Sugden. February 13th, 1918. (124,017.)

2,615. Alternating current dynamo-electric machines adapted for synchronous working. L. J. Hunt & Sandycroft, Ltd. February 13th, 1918. (Cognate application, 3,379/18.) (124,018.)

3,643. Construction of gas and electric fittings, candlesticks, and ornaments generally. J. Harrington. March 1st, 1918. (124,022.)

4,337. Electrical contact-making and breaking apparatus. British Thomson-Houston Co. & A. Young. March 12th, 1918. (124,041.)

4,530. Manufacture of electric accumulators. H. Leitner & W. H. Exley. March 14th, 1918. (124,050.)

4,548. Luminous signal or call device. J. L. Morisons. October 30th, 1917. (120,193.)

4,556. Signalling and navigation lamps, and switching devices more particularly applicable thereto. A. H. Morse. March 14th, 1918. (124,053.)

4,868. Method and apparatus for electric heating by high-frequency currents. Ajax Metal Co. September 19th, 1917. (119,220.)

4,869. Magneto-electric machines. R. B. North & A. M. Allen. March 19th, 1918. (124,064.)

4,965. Electric switches. Drake, Ltd., & J. W. Drake. March 21st, 1918. (124,066.)

5,166. Devices of the vibrated-diaphragm type for giving audible signals. J. F. Monnot. March 23rd, 1918. (124,071.)

5,323. Lampholders for incandescent electric lamps. L. C. D. Delanne. March 19th, 1917. (114,432.)

5,479. Apparatus for electrolysing salt solution. T. Matsushima. March 28th, 1918. (Convention date not granted.) (114,623.)

5,953. Elbows and like fittings for electric conduits. J. Wilkie. April 8th, 1918. (124,082.)

7,355. Means for regulating and measuring alternating magnetic fluxes and forces, particularly in testing machines. B. P. Haigh. May 2nd, 1918. (124,100.)

7,849. Tubular earths for electrical conductors. K. W. Hedges. May 10th, 1918. (Patent of addition not granted.) (124,102.)

7,866. Minimum current cut-out and apparatus for regulating the tension and the voltage and current from a dynamo. R. B. Ransford (Fabbrica Italiana Automobili Torino). March 10th, 1918. (124,104.)

8,870. Electric transformers, inductances and the like. British Thomson-Houston Co. (General Electric Co., U.S.A.) May 29th, 1918. (124,113.)

10,049. Reverse-current electric devices of the Wheatstone relay type. British Thomson-Houston Co. & E. B. Wedmore. June 18th, 1918. (124,126.)

11,340. Electric motor starters. A. H. Railing & W. Wilson. July 11th, 1918. (124,136.)

11,464. Process of resuscitating spent electric dry cells. K. Horii. July 12th, 1918. (124,137.)

11,804. Directional aerials for use in wireless telegraphy. G. M. Wright. July 18th, 1918. (124,138.)

12,414. Devices of the vibrated-diaphragm type for giving audible signals. J. F. Monnot. July 30th, 1918. (124,141.)

1919.

1,633. Sparking plug for internal-combustion engines and method of manufacturing the same. C. E. Gerbaud. May 29th, 1918. (124,177.)

East Prussian Peat Industry.—A peat industry for East Prussia has been founded at Königsberg. It is hoped that this may relieve the fuel difficulty. Hitherto the peat available for household use has been expensive and of poor quality. The new industrial association will encourage the output and utilisation of peat, as well as systematic prospecting for peat layers. It will introduce better methods of working the peat and secure cheaper means of transport. (*D.A.Z.*, March 21st.)